Appendices

Appendix A:

Bound Brook Watershed Hydraulics and Sediment Impact Analyses Modeling

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1. Introduction

1.1. Purpose

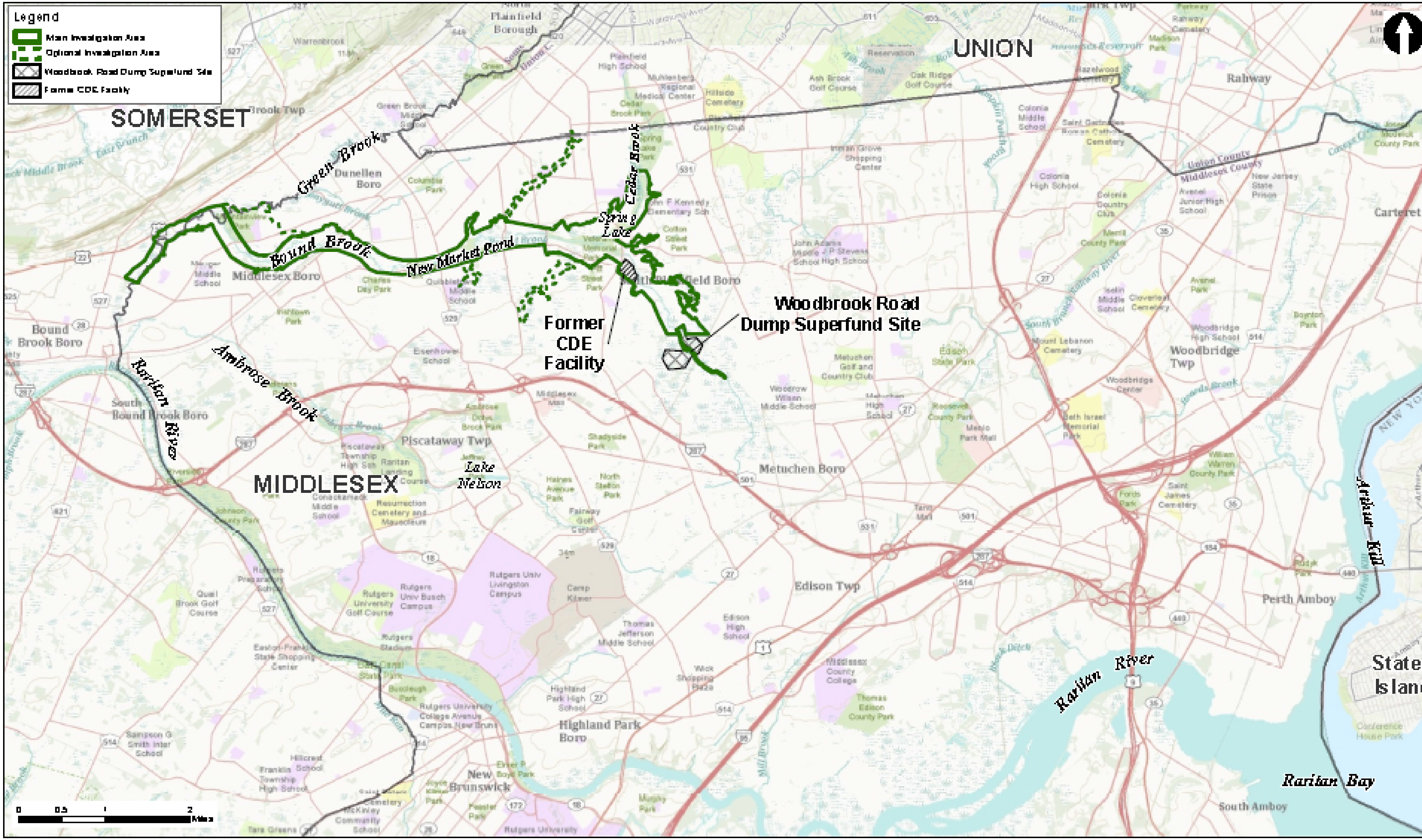
The Bound Brook hydraulic and sediment impact modeling analyses are one of the decision making tools used to evaluate potential remedial alternatives for reducing ecological and human health risks posed by contaminated sediments in Bound Brook, New Jersey. Bound Brook, located in Middlesex County, New Jersey, is a secondary tributary of the Raritan River that flows into Raritan Bay (south of Staten Island, New York) and into the Greater New York/New Jersey Harbor (Figure 1-1). Bound Brook is part of Operable Unit (OU) 4 of the Cornell-Dubilier Electronics (CDE) Superfund Site (Site) [EPA ID: NJD981557879] located in South Plainfield, New Jersey. Cornell-Dubilier Electronics, Inc. operated a facility at 333 Hamilton Boulevard from 1936 to 1962, manufacturing electronic parts and components including capacitors. During site operations, the company released/buried material contaminated with polychlorinated biphenyls (PCBs) and chlorinated volatile organic compounds (CVOCs), primarily trichloroethene (TCE), contaminating on-site soils. As part of the ongoing RI/FS process for OU4 (Section 1.0 of the Draft Final Focused Feasibility Report, 2014), USEPA has detected elevated levels of PCBs and CVOCs in the surface water and sediments of Bound Brook adjacent to the former CDE facility's northeast property line.

The objective of this Bound Brook modeling effort is to use established models that adequately represented the processes affecting stream hydraulics, sediment supply, and sediment transport, especially since hydrophobic contaminants, like PCBs, are preferentially transported in the particulate phase and sorbed to fine-grained sediments. The model simulated results were used to assess the relative impacts of stream flow and sediment transport in Bound Brook under various remediation scenarios.

1.2. Modeling Approach

The hydraulics and sediment impact modeling analyses were conducted for Bound Brook from immediately downstream of Belmont Avenue Bridge (RM6.87) to its confluence with Green Brook (RM0) (Figure 1-2). The modeling framework developed for the Bound Brook RI/FS consisted of:

- <u>A watershed model that provided inputs of runoff and sediments into the in-stream hydraulics and sediment analyses model</u>. The hydrologic model Soil Water Assessment Tool [SWAT; (Arnold *et. al.,* 1998)] Version 2009 was selected to perform the simulation of continuous water movements and sediment yield through various types of land uses in the watershed. Please note that SWAT is a continuous-time simulation, semi-distributed, quasi-process-based watershed model and the ArcSWAT interface was used to prepare the inputs into the SWAT model.



U.S. Army Corps of Engineers
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Appendix A – Hydraulics and Sediment Impact Analyses Modeling

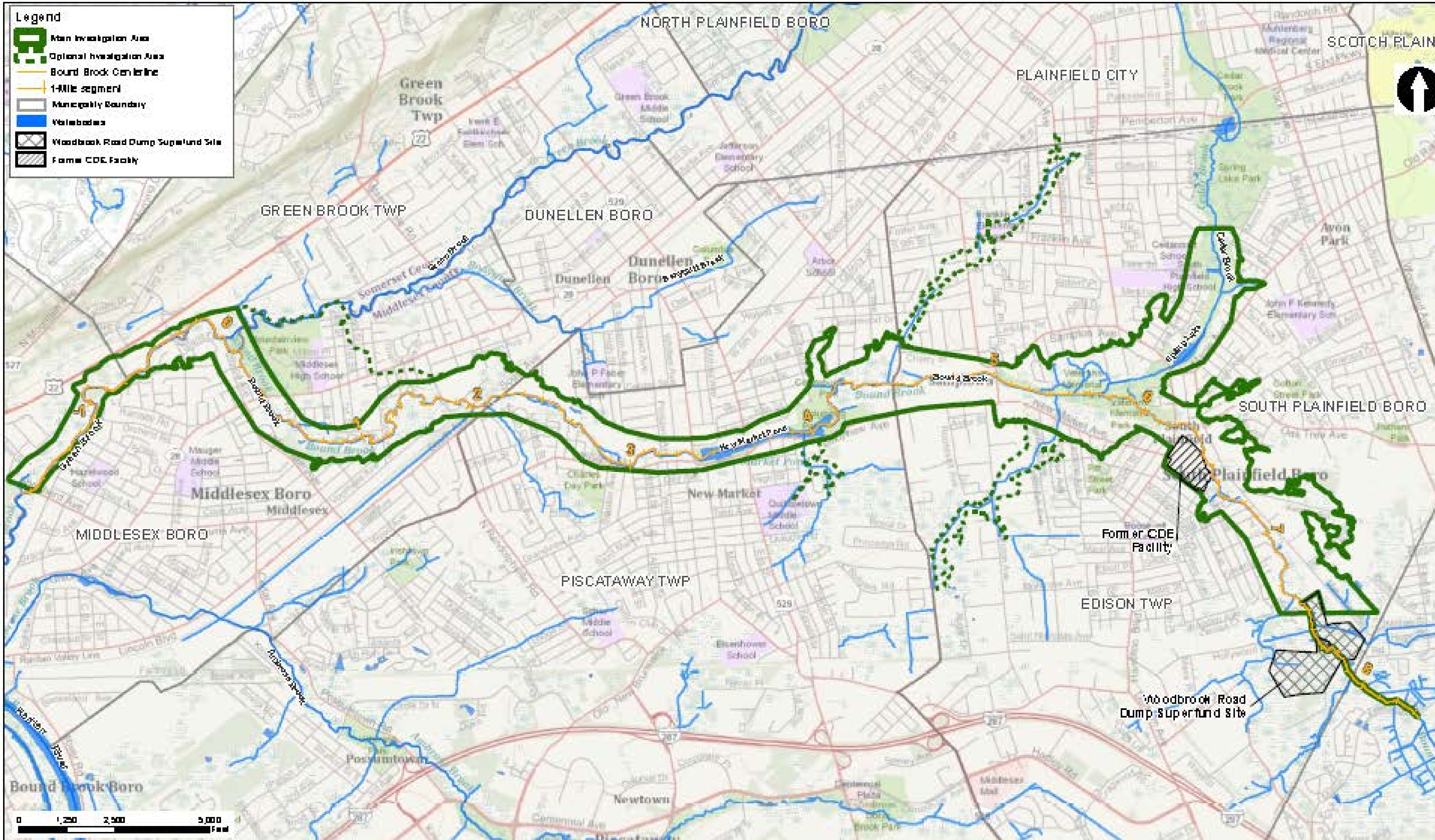
Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

OU4 Bound Brook Regional Location Map

Bound Brook OU4 RI/FS

2013

Figure 1-1



Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

OU 4 Bound Brook Study Area

Bound Brook OU4 RI/FS

2013

Figure 1-2

- An in-stream hydraulic and sediment impact analysis model was prepared using the Hydrologic Engineering Center-River Analysis System (HEC-RAS) as part of this component of the modeling framework. The HEC-RAS is a one-dimensional and physically-based modeling system to analyze river flow, sediment, and water quality dynamics. HEC-RAS was selected because it has been present in the public realm for more than 15 years and has been peer reviewed (USACE, 2010a,b). It is freely available for download from the HEC website and is supported by the US Army Corps of Engineers. It is also widely used by many government agencies and private firms. The SWAT model and HEC-RAS were externally coupled[1], such that the results of the SWAT model were used as an input to the HEC-RAS model without changing the codes of the models.
- A sediment assessment model was constructed within HEC-RAS, using the SIAM (Sediment Impact Assessment Model) feature. The SIAM tool was recommended by USACE for sediment assessment in this study because it is already part of the HEC-RAS modeling system.

[1] External coupling occurs when one program calls another program (executable file) explicitly, and there is a mechanism of external data exchange, either by a text file I/O or by more sophisticated inter-process communication (Yahiaoui *et. al.*, 2004).

2. Watershed Modeling

2.1. Watershed Study Area

The headwaters of Bound Brook originate in areas of residential and commercial/industrial development in Edison Township (see Figure 1-2). Bound Brook flows westerly through South Plainfield into Piscataway Township, where the water is dammed to form New Market Pond. The brook flows through Middlesex Borough to the confluence with Green Brook, a tributary of the Raritan River.

The Bound Brook watershed up to its confluence with Green Brook (Figure 1-2) is un-gauged. Consequently, the Green Brook watershed was included in the study to help with the calibration of Bound Brook flows, since the USGS gauge (Gauge ID: 01403900) is located immediately below the confluence of Bound Brook and Green Brook and provides the only measured/observed flow data with long-term flow measurements dating back to 1972. However, continuous flows were only measured in the period between 2004 and 2011. Figure 2.1 depicts the Bound Brook watershed area (approximately 27 square miles) and the Green Brook watershed area (area without black sub-basin polygons). Bound Brook has elevations ranging from 12 m to 59 m (NAVD88), while the elevation in the Bound Brook and Green Brook watershed ranges from 12 m to 172 m (NAVD88).

2.2. Watershed Modeling Methodology

The GIS interface for SWAT model (ArcSWAT) was used to develop the inputs for simulating the Bound Brook watershed flows and sediment. The ArcSWAT GIS Interface, Version 10.1 was used for model parameterization. Total years of study were from the period of 2004 to 2011, when continuous flow data were available from the above listed USGS gauge (Gauge ID: 01403900). The year 2004 was used as a warm-up period for the model while 2005 through 2007 was used for model calibration and 2008 through 2011 was used for model validation. This division of the entire 2005-2011 period into calibration and validation periods ensures that both periods have a similar number of wet and dry years.

SWAT-CUP version 4.3.7 (Abbaspour *et. al.,* 2007) was used for sensitivity analysis and model calibration. SWAT-CUP provides a decision making framework that incorporates a semi-automated approach (SUF12) using both manual and automated calibration and incorporates a sensitivity and uncertainty analysis. In SWAT-CUP, users can manually adjust parameters and ranges iteratively between autocalibration runs. Parameter sensitivity analysis helps focus the calibration and uncertainty analysis and is used to provide statistics for goodness-of-fit.

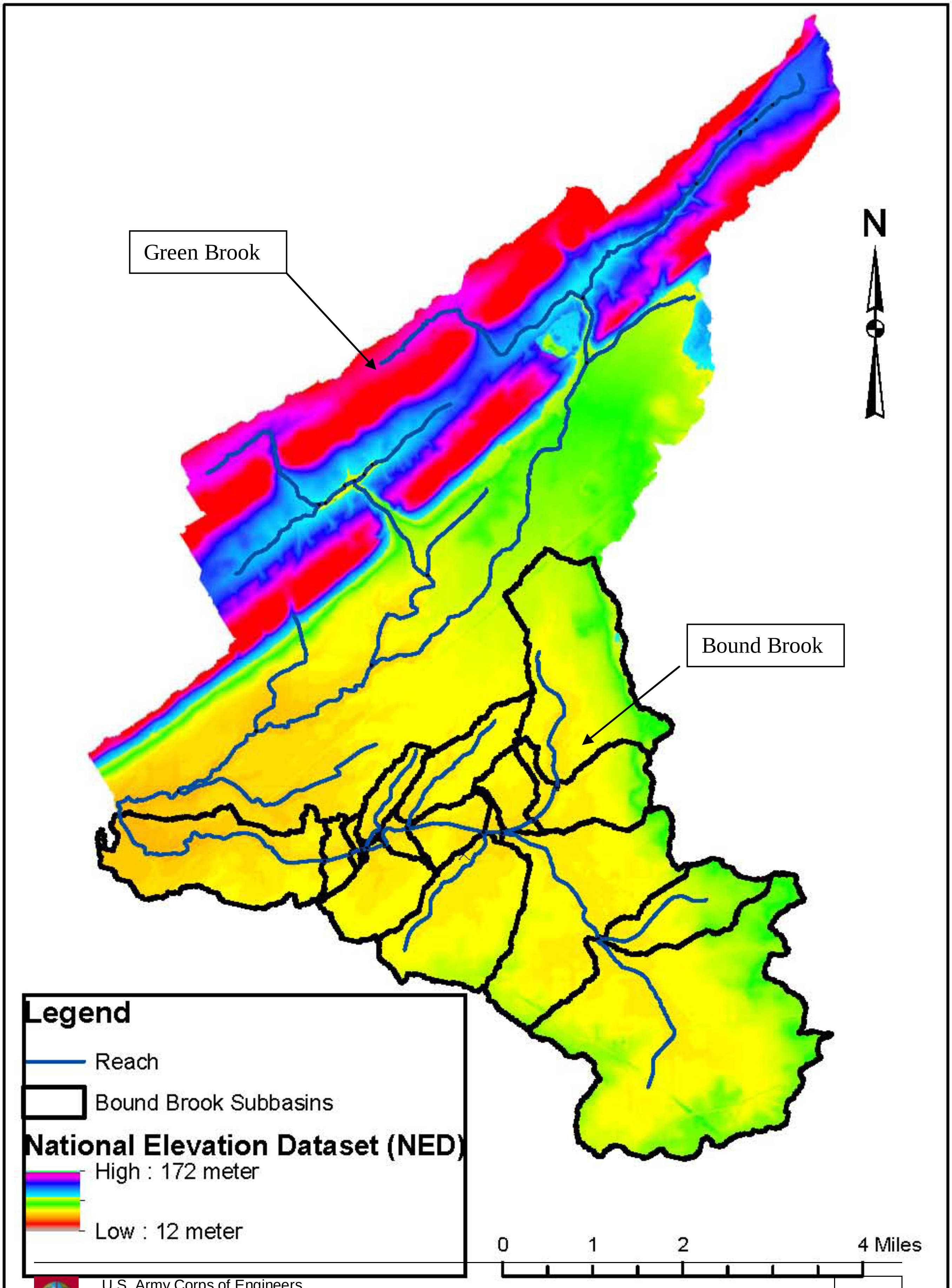


Figure 2.1: Bound Brook Watershed (marked in bold black line) and Green Brook Watershed

2.3. Principles of the SWAT Model

SWAT is a continuous-time simulation, semi-distributed, quasi-process-based watershed model. The model operates on a daily time step and was developed to evaluate the effects of alternative management decision on water resources and non-point-source pollution in ungauged watersheds. Major model components include weather, hydrology, soil temperature and properties, plant growth, nutrients, pesticides, bacteria and pathogens, and land management. The hydrologic components of SWAT are based on the water balance equation applied to water movement through soil. The water balance equation takes into account several different processes, including: precipitation, surface runoff, evapotranspiration, recharge, and soil water storage. The water balance is expressed in SWAT as follows:

$$SW_t = SW_0 + \sum_{i=1}^{t}\left(R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw}\right) \tag{1}$$

Where

SW_t = soil water content at time t (mm)
SW_0 = initial soil water content of day i (mm)
R_{day} = amount of precipitation on day i (mm)
Q_{surf} = amount of surface runoff on day i (mm)
E_a = amount of evapotranspiration on day i (mm)
W_{seep} = amount of water percolation to the bottom of the soil profile on day i (mm)
Q_{gw} = amount of water returning to the ground water on day i (mm)
t = time (in days)

The structure of the SWAT model can be summarized as follows:

- The SWAT model subdivides the watershed into several sub-watersheds, which are further divided into hydrological response units (HRUs) according to topography, land use, and soil. The number of HRUs in a sub-watershed is determined by the threshold value for land use and soil delineation in the sub-watershed (Neitsch *et. al.*, 2011). The delineation of the HRUs within the sub-watershed is determined using ArcSWAT built-in tools (Winchell *et. al.*, 2007). The use of HRUs generally simplifies a simulation run because all similar soil and land-use areas are lumped into a single response unit.
- The hydrologic cycle is climate driven and provides moisture and energy inputs, such as daily precipitation, maximum/minimum air temperature, solar radiation, wind speed, and relative humidity, that control the water balance. The water balance in each HRU is represented by four storage volumes: snow, soil profile (0-6.5 feet), shallow aquifer (typically 6.5-65 feet) and deep aquifer (> 65 feet). Snow is computed when temperatures are below freezing, and soil temperature is computed because it impacts water movement in the soil.
- As precipitation descends, it may be intercepted and held in the vegetation canopy or fall to the surface of the soil. Water on the soil surface will infiltrate into the soil profile or flow overland as surface runoff. Runoff moves relatively quickly towards a stream channel and contributes to short-term stream response. Infiltrated water may be held in the soil and later

evapotranspirated or it may slowly make its water to the surface-water system via underground paths. The potential pathways of water movement simulated by SWAT in the HRU are given in Figure 2.2.

- Surface runoff occurs whenever the rate of eater application to the ground surface exceeds the rate of infiltration. In this study, surface runoff from daily precipitation is estimated using the Soil Conservation Service (SCS) curve number (CN) method as implemented in SWAT.

- The soil profile is subdivided into multiple layers that may have differing soil-water processes including infiltration, evaporation, plant uptake, lateral flow, and percolation to lower layers. The soil percolation component of SWAT uses a storage routing technique to predict flow through each soil layer in the root zone. Downward flow occurs when field capacity (the water content to which a saturated soil drains under gravity) of a soil layer is exceeded and the layer below is not saturated. Percolation from the bottom of the soil profile recharges the shallow aquifer. When the temperature in a particular layer is equal to or below 48°F, no percolation is allowed from that layer. Lateral subsurface flow in the soil profile is calculated simultaneously with percolation, and this can contribute to stream flow.

- Water that moves past the lowest depth of the soil profile by percolation or bypass flow enters the vadose zone before becoming shallow and/or deep aquifer recharge. The shallow aquifer contributes base flow to the main channel or reaches within each subbasin. Base flow is allowed to enter the reach only when the amount of water stored in the shallow aquifer exceeds a threshold value. Water entering the deep aquifer is not considered in future water budget calculations and is considered to be lost from the system..

- SWAT uses the Modified Universal Soil Loss Equation (MUSLE) (Williams, 1995) to predict sediment yield from the landscape. Sediment yield is the total sediment volume delivered to a specified location in the basin, divided by the effective drainage area above that location for a specified period of time.

$$sed = 11.8 \cdot \left(Q_{surf} \cdot q_{peak} \cdot area_{hru}\right)^{0.56} \cdot K \cdot C \cdot P \cdot LS \cdot CFRG \qquad (2)$$

where

sed = sediment yield on a given day (metric tons)
Q_{surf} = surface runoff volume (mm/ha)
Q_{peak} = peak runoff rate (m^3/s)
$area_{hru}$ = area of HRU (ha)
K = soil erodibility factor (0.013 metric ton m^2/hr/(m^3-metric ton cm))
C = cover and management factor
P = support practice factor
LS = topographic factor
CFRG = coarse fragment factor

- Flows and sediment yield from each HRU in a subwatershed are combined, and the resulting flow and loads are routed through channels (Neitsch and others, 2005), ponds, and (or) reservoirs to the watershed outlet. In this study, channel flow is routed by Muskingum method, and channel sediment is routed based on the modified Bagnold’s sediment transport equation.

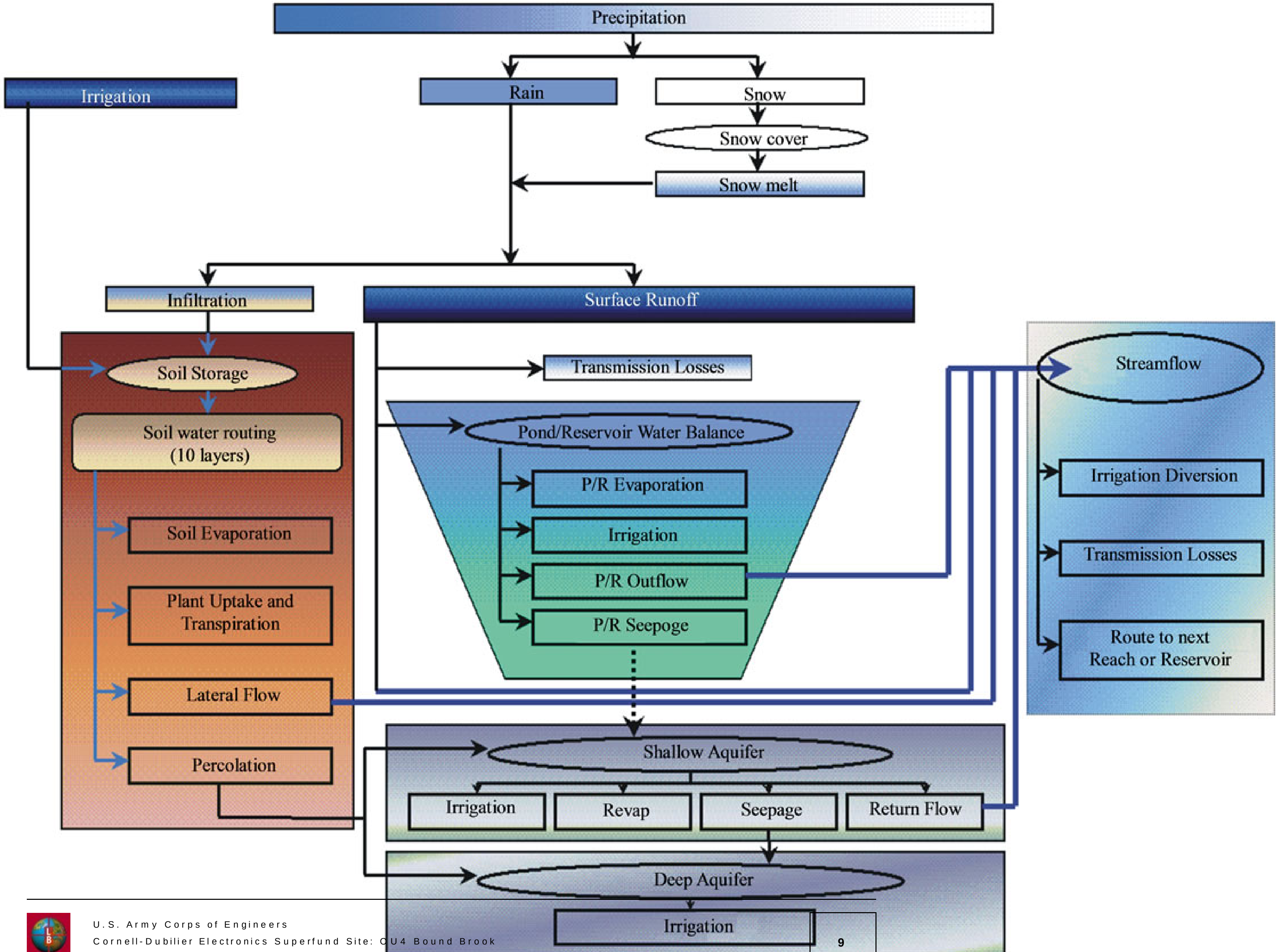


Figure 2.2: Schematic of pathway available for water movement in SWAT (after Neistch *et. al*, 2009)

2.4. Model Components and Input Data

The steps involved in creating and running SWAT model are given in Figure 2.3 below. The major model inputs are topography[2], soil properties (such as texture, soil erodibility, hydraulic conductivity, hydrologic soil group, soil depth, organic matter content, available water capacity), land use/cover type, weather/climate, and land management practices. Using the site topography, the SWAT ArcGIS interface delineates the stream and partitions the watershed into subwatersheds, which are positioned in the watershed and are related to one another spatially (*e.g.*, outflow from upstream sub-watershed number 3 may enter downstream subwatershed number 6). The subwatersheds are further processed and divided into the HRUs. SWAT then uses the input data from the user to create inputs files with different levels of detail for the watershed, subwatershed, or HRU. Watershed level inputs are used to model processes throughout the watershed, while subwatershed or HRU inputs files are used to identify unique processes to specific subwatershed or HRUs.

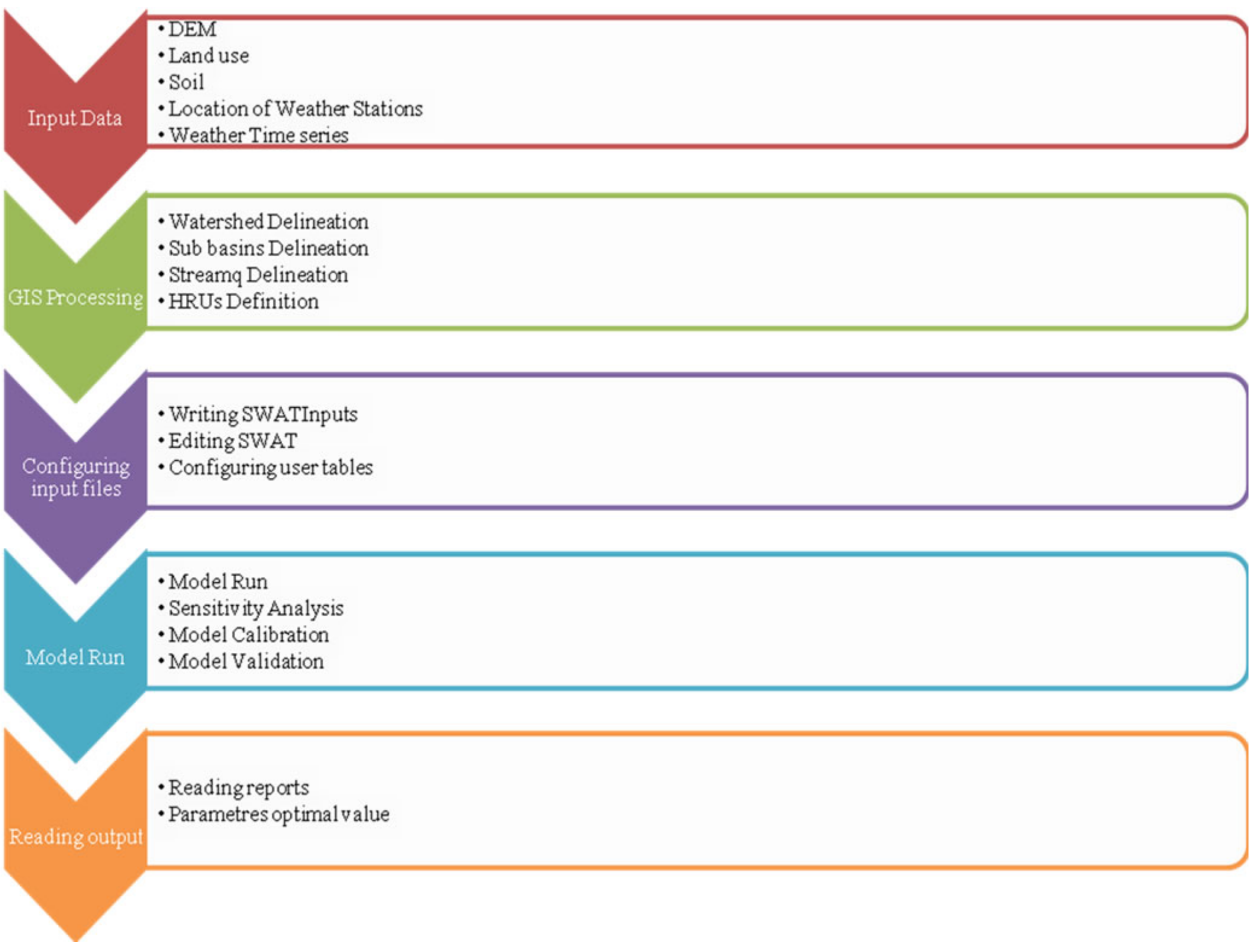


Figure 2.3 Components and input/output data of SWAT Model (after Kharchaf et al., 2013)

[2] The topography is represented by three-dimensional or a digital elevation model (DEM) in Figure 2.3

2.4.1. Watershed National Elevation Dataset (NED) and Watershed Delineation

The National Elevation Dataset (NED) 1/9 Arc Second assembled by the U.S. Geological Survey was used in representing the elevation terrain of the watershed. NED 1/9 Arc Second data are Light Detection and Ranging (LIDAR) data. Data unit is meters with a geographic projection. Data has a vertical datum of NAVD88 and a horizontal projection of NAD83. The resolution of the data is approximately 3 meters with a vertical accuracy of +/- 1 meter. For this modeling effort, NED data was re-projected to New Jersey State Plane Coordinate with metric units (meters). Approximate watershed elevation range between 12 meters to 172 meters with reference to NAVD88 (Figure 2.2).

Using the Automatic Delineator command in ArcSWAT, the re-projected NED topographic map in ESRI GIS format was imported to start the watershed delineation processes. Watershed delineation involves the use of advanced GIS functions to aid the user in segmenting the watershed into several hydrologically connected sub-watersheds for use in the SWAT. When the automated delineation was completed for Bound Brook watershed, it was observed that one of the tributaries that flow into Bound Brook was delineated to flow into Green Brook; inconsistent with the surface water quality shapefiles downloaded from the NJDEP website (http://www.state.nj.us/dep/gis/stateshp.html#SWQS). Therefore, manual adjustments were made to ArcSWAT's delineation to match the stream network in the NJDEP shapefiles. The stream network and the delineated sub-watershed that were finally used in the SWAT model are depicted in Figure 2.2.

2.4.2. Watershed Land Use Data

The USGS National Land Cover Database (NLCD) 2006 Land Cover data were used to represent the land use in the watershed. Data resolution is 1 arc second (approximately 30 meters). For consistency with the NED data described in Section 2.4.1, data was re-projected to New Jersey state plane coordinate with a horizontal datum of meter NAD83. There are 15 classes of land use types in the Bound Brook watershed (Figure 2.3). The percent area represented by each land use is listed in Table 2.1.

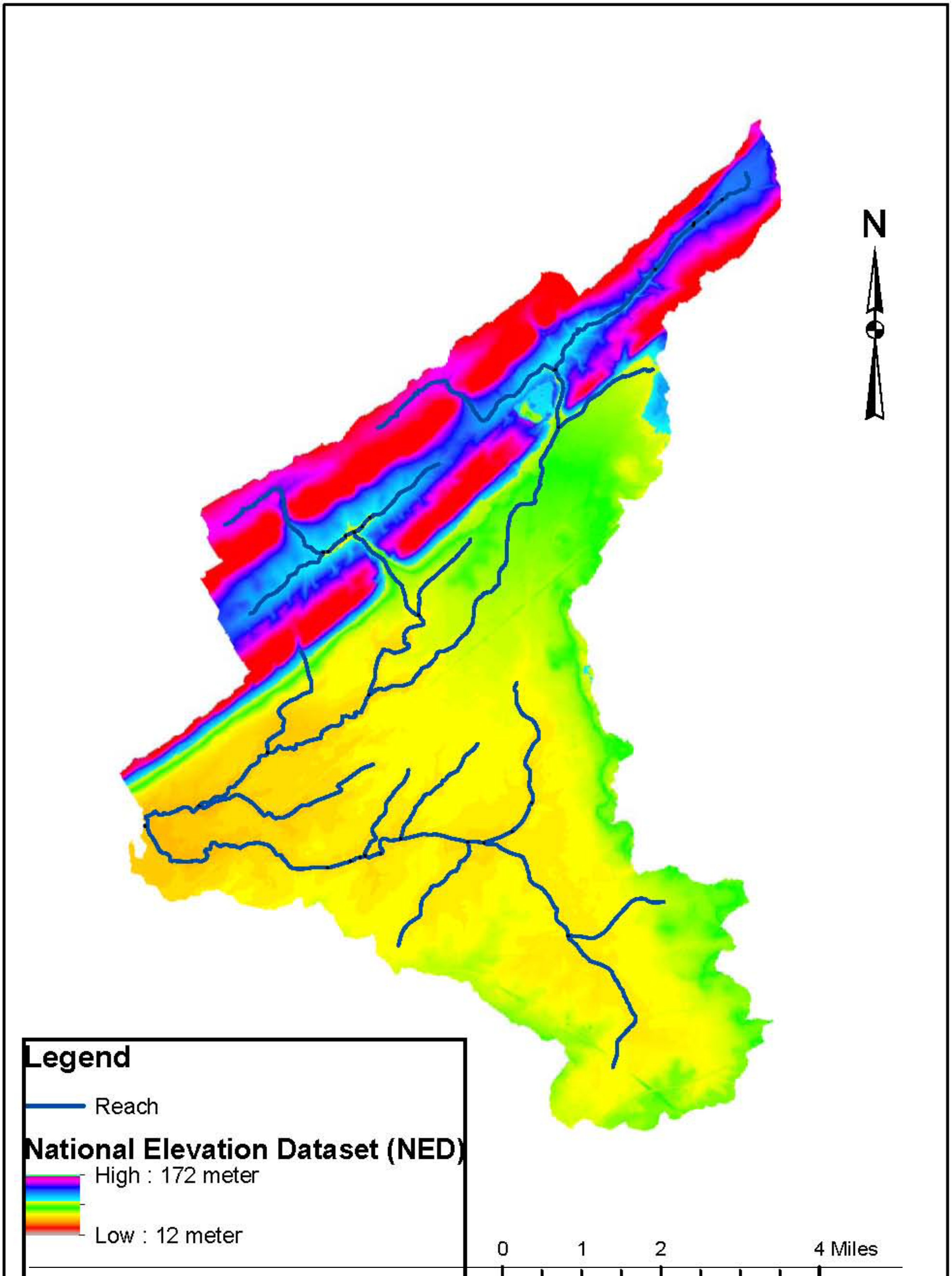


Figure 2.2: National Elevation Dataset for the Bound Brook and Green Brook Watersheds

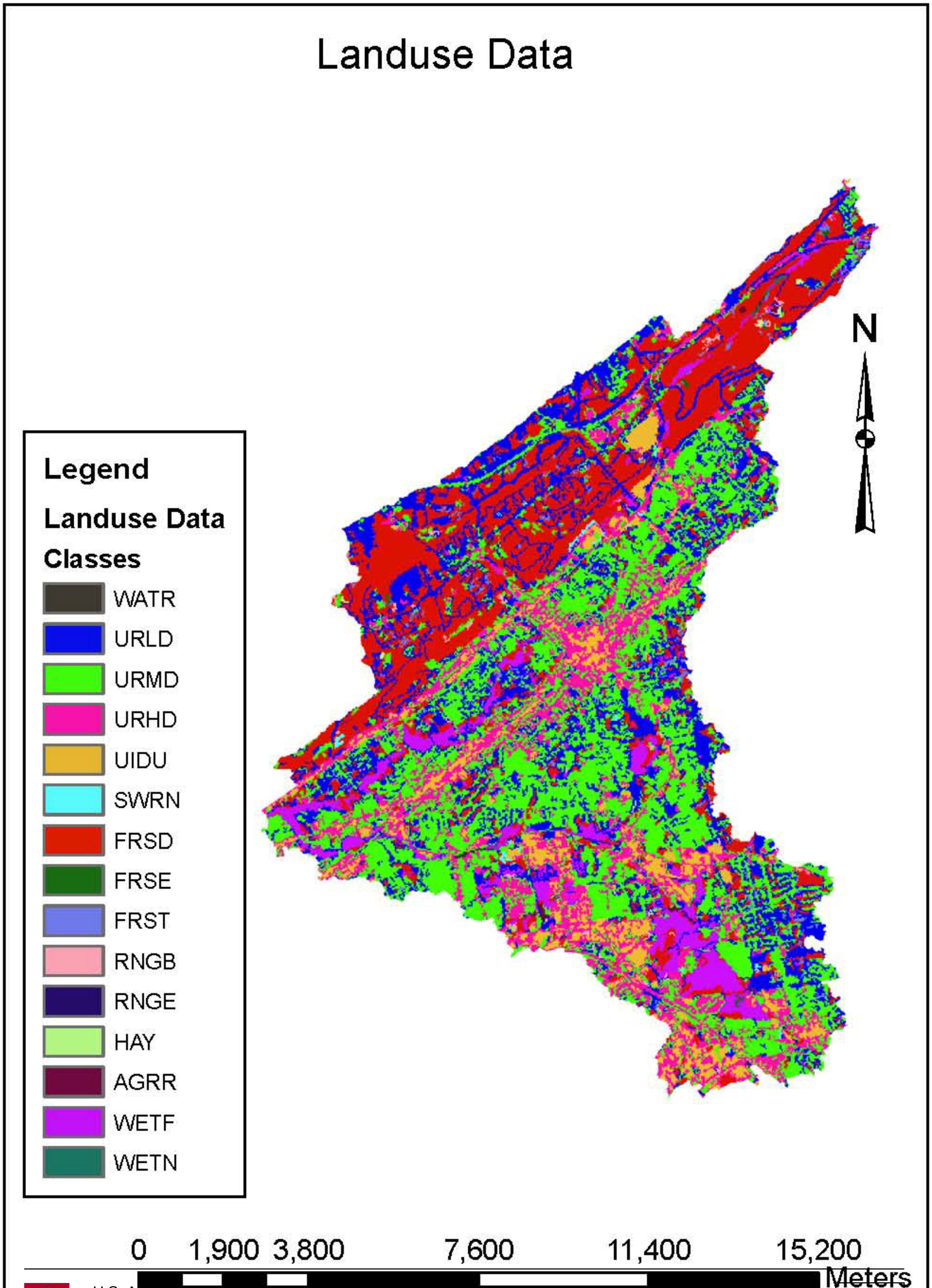


Figure 2.5: Watershed Land Use Classification for the Bound Brook and Green Brook Watersheds

Table 2.1: Land Use Percent Areas

Land Use	**Area (%)**
Water (WATR)	0.1%
Residential-Low Density (URLD)	21.3%
Residential-Medium Density (URMD)	30.1%
Residential-High Density URHD	13.2%
Industrial (UIDU)	5.4%
Range (SWRN)	0.2%
Forest-Deciduous (FRSD)	23.0%
Forest-Evergreen (FRSE)	0.1%
Forest (FRST)	1.0%
Range-Brush (RNGB)	0.4%
Range-Grasses (RNGE)	<0.1%
Hay (HAY)	<0.1%
Agricultural Land-Row Crops (AGRR)	0.1%
Wetlands-Forested (WETF)	5.0%
Wetlands-Non-Forested (WETN)	0.1%

2.4.3. Watershed Soil Data

The USGS Soil Survey Geographic (SSURGO) data were used in classifying the soil characteristics of the watershed. The SSURGO data consists of digital georeferenced spatial data, attribute data, and metadata. The SSURGO data provides the most detailed level of information and was designed primarily for farm and ranch, landowner/user, township, county, or parish natural resource planning and management. Using the soil attributes, these data serve as a resource for the determination of erodible areas, developing erosion control practices, making land use assessments and chemical fate assessments. For consistency with the NED and landuse data described in Sections 2.4.1 and 2.4.2, SSURGO data were re-projected to New Jersey state plane coordinates with a horizontal datum of meter NAD83. There are over 100 classes of soil in the Bound Brook watershed (Figure 2.4) and the percent area represented by each soil group is shown in Table 2.2.

2.4.4. Meteorological Data

Two precipitation weather stations namely, NOAA gauge in Plainfield NJ (Gauge ID: 287079) and NOAA gauge in Bound Brook, NJ (Gauge ID: 280927) were used to represent precipitation in the watershed. The Plainfield gauge was also used to represent temperature in the watershed. Relative humidity and wind speed in the watershed were represented by the NOAA weather station in Sommerville Sommerset airport (station ID: KSMQ). Solar radiation was computed by the SWAT model since no measured solar radiation is available. These gauges were selected because they represent weather stations with available long-term data closest to the study area. Weather stations locations with respect to the project site are shown in Figure 2.5.

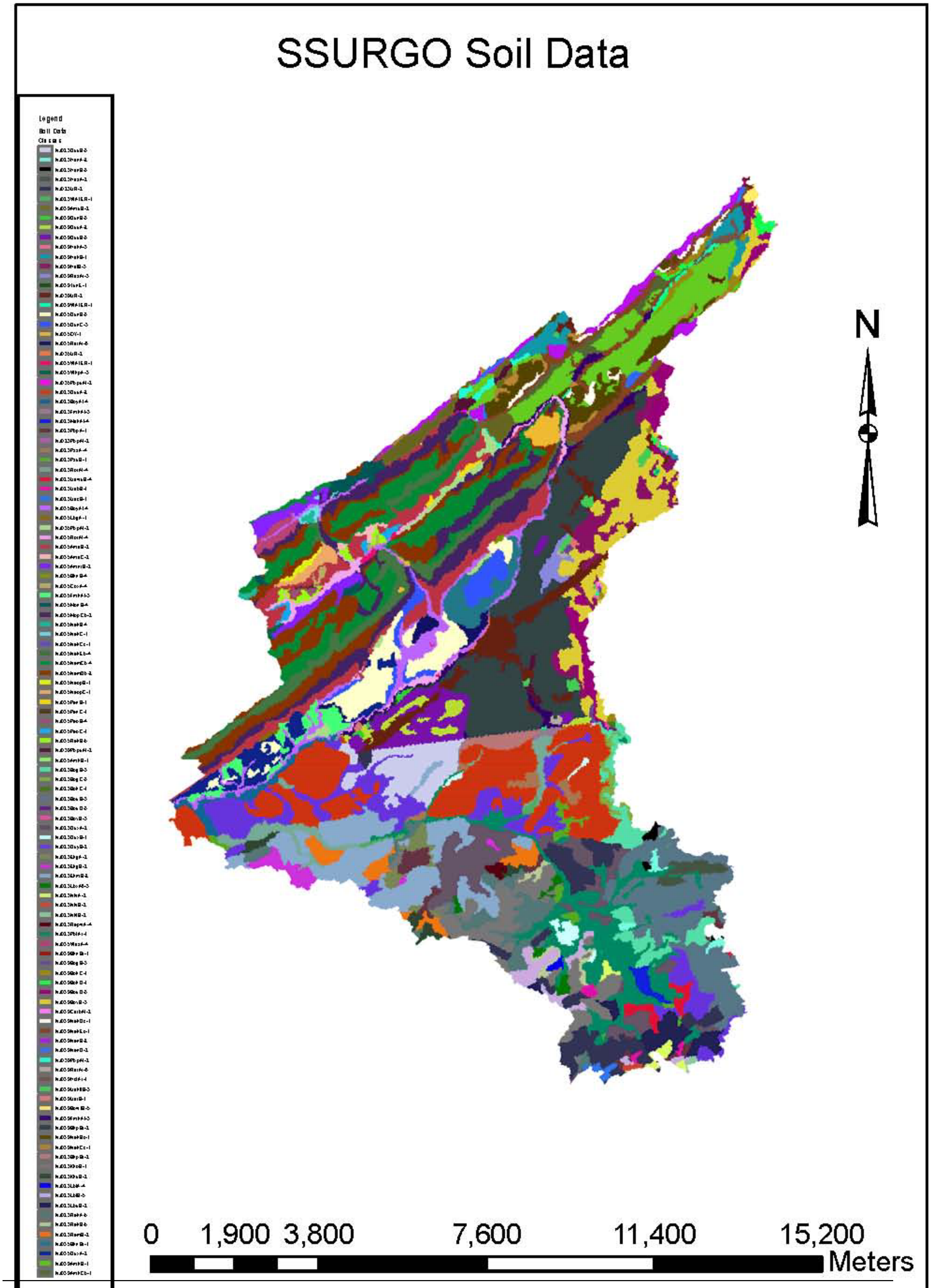


Figure 2.4: Watershed Soil Data for the Bound Brook and Green Brook Watersheds

Table 2.2: Soil Group Percent Areas

Soil Type	Area (%)	Soil Type	Area (%)	Soil Type	Area (%)	Soil Type	Area (%)
NJ023DuuB-3	1.70%	NJ023PbpA-1	0.50%	NJ035PeoB-4	0.10%	NJ039CarbAt-2	0.00%
NJ023HanA-2	0.20%	NJ023PbpAt-2	0.00%	NJ035PeoC-1	0.20%	NJ039NehDc-1	0.30%
NJ023HanB-3	0.10%	NJ023PssA-4	0.30%	NJ035RehB-5	0.20%	NJ039NehEc-1	1.30%
NJ023HasA-2	0.40%	NJ023PsuB-1	0.40%	NJ039PbpuAt-2	0.20%	NJ039NenB-2	0.90%
NJ023UR-2	2.30%	NJ023RorAt-4	0.90%	NJ035AmhB-1	0.00%	NJ039NenD-2	0.20%
NJ023WATER-1	0.10%	NJ023UdwuB-4	0.30%	NJ023BogB-3	1.30%	NJ039PbpAt-2	0.20%
NJ039AmuB-2	0.80%	NJ023UdbB-1	0.10%	NJ023BogC-3	0.20%	NJ039RarAr-6	0.10%
NJ039DunB-3	0.10%	NJ023UdcB-1	0.10%	NJ023BohC-1	0.00%	NJ039HctAr-1	0.10%
NJ039DuuA-2	0.50%	NJ035BoyAt-4	1.60%	NJ023BouB-3	3.70%	NJ039UdkttB-3	0.20%
NJ039DuuB-3	1.40%	NJ035PbpAt-2	0.40%	NJ023BouD-3	0.00%	NJ039UdrB-1	0.00%
NJ039HakA-3	0.00%	NJ035RorAt-4	0.70%	NJ023BovB-3	0.00%	NJ039BowtB-5	0.10%
NJ039HakB-1	0.80%	NJ035AmdB-2	2.90%	NJ023DuxA-2	2.60%	NJ039FmhAt-3	0.70%
NJ039HatB-3	1.30%	NJ035AmdC-2	0.10%	NJ023DuxB-1	0.30%	NJ039BhpBr-2	7.00%
NJ039RasAr-3	0.30%	NJ035AmnrB-2	0.70%	NJ023DuyB-2	3.90%	NJ039NehBc-1	1.40%
NJ039TunE-1	0.00%	NJ035BhnB-4	0.00%	NJ023EkgA-2	0.40%	NJ039NehCc-1	0.30%
NJ039UR-2	2.10%	NJ035CoxA-4	0.10%	NJ023EkgB-2	0.40%	NJ023BhpBr-2	0.30%
NJ039WATER-1	0.10%	NJ035FmhAt-3	0.60%	NJ023EkmB-2	3.70%	NJ023KkoB-1	2.20%
NJ035DunB-3	1.90%	NJ035MonB-4	0.40%	NJ023LbxA6-3	0.20%	NJ023KkuB-2	0.30%
NJ035DunC-3	0.90%	NJ035MopCb-2	3.80%	NJ023NkrA-2	0.20%	NJ023LbtA-4	0.10%
NJ035QY-1	0.40%	NJ035NehB-4	0.10%	NJ023NkrB-2	0.00%	NJ023LbtB-5	0.60%
NJ035RarAr-6	0.30%	NJ035NehC-1	0.10%	NJ023RepwA-4	0.10%	NJ023LbuB-2	0.80%
NJ035UR-2	0.00%	NJ035NehCc-1	0.00%	NJ023PbtAr-1	3.80%	NJ023RehA-5	1.40%
NJ035WATER-1	0.10%	NJ035NehEb-4	2.30%	NJ035WasA-4	0.30%	NJ023RehB-5	0.30%
NJ035WhpA-3	0.00%	NJ035NemCb-4	4.20%	NJ039BhnBr-1	0.00%	NJ023RemB-2	0.80%
NJ035PbpuAt-2	0.00%	NJ035NemDb-2	3.90%	NJ039BogB-3	0.10%	NJ035BhnBr-1	0.90%
NJ023DuuA-2	6.30%	NJ035NeopB-1	0.10%	NJ039BohC-1	0.40%	NJ035DuxA-2	1.00%
NJ023BoyAt-4	0.50%	NJ035NeopC-1	0.30%	NJ039BohD-1	0.20%	NJ039AmhB-1	3.30%
NJ023FmhAt-3	0.10%	NJ035PenB-1	0.10%	NJ039BouD-3	1.00%	NJ039AmhCb-1	0.40%
NJ023MakAt-4	0.20%	NJ035PenC-1	0.00%	NJ039BovB-3	3.10%		

Daily precipitation measured at the Plainfield and Bound Brook gauges from 2004 to 2011 are depicted in Figure 2.6. Note that precipitation data are not available at the Plainfield gauge for part of 2008 and for the entire 2009 year. When data for both gauges were available, they were averaged; when the data from the Plainfield gauge was not available, the NOAA gauge was used. A plot of daily precipitation recorded at both stations (Figure 2-7) reveals significant scatter around the 1 to 1 line. This evaluation suggests that there are spatial differences in the daily precipitation amounts recorded at the two stations.

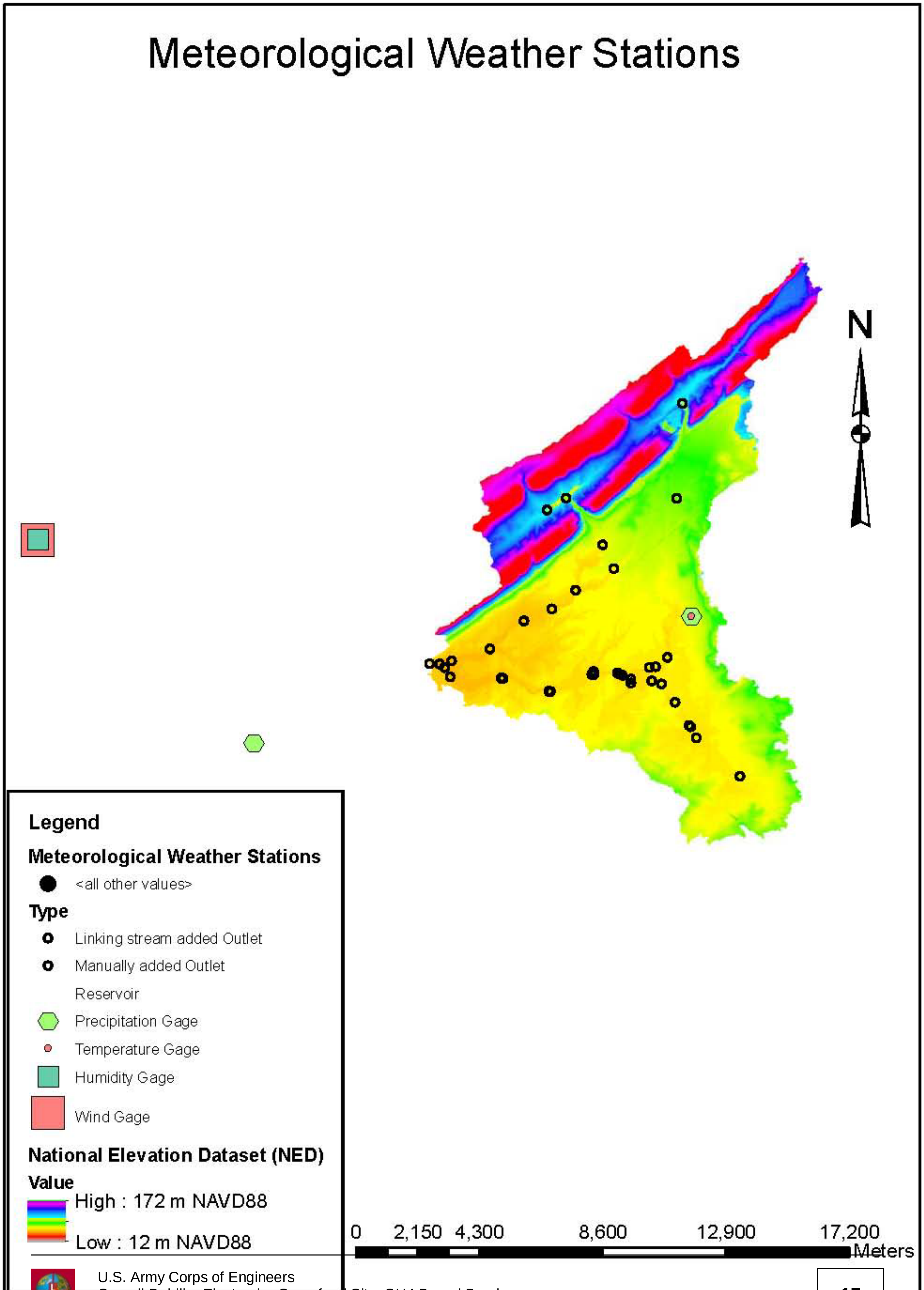
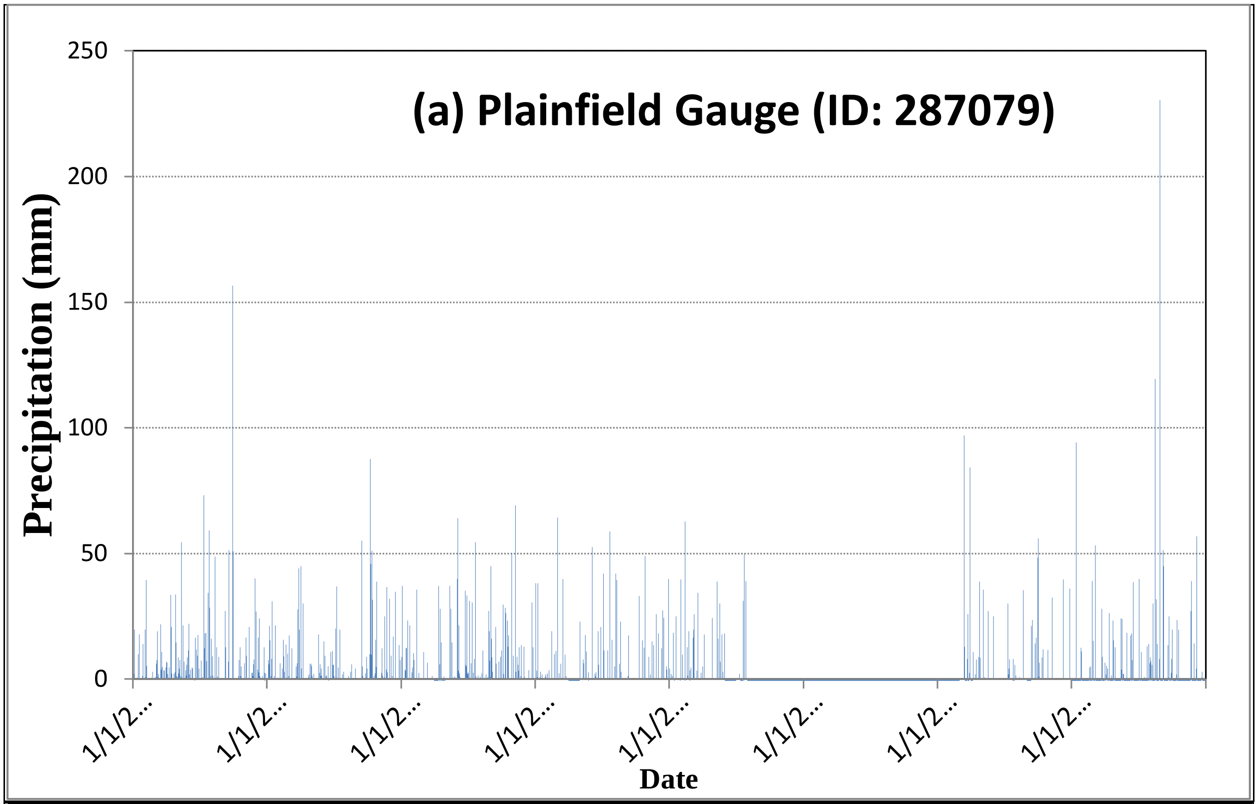


Figure 2.5: Meteorological Weather Stations



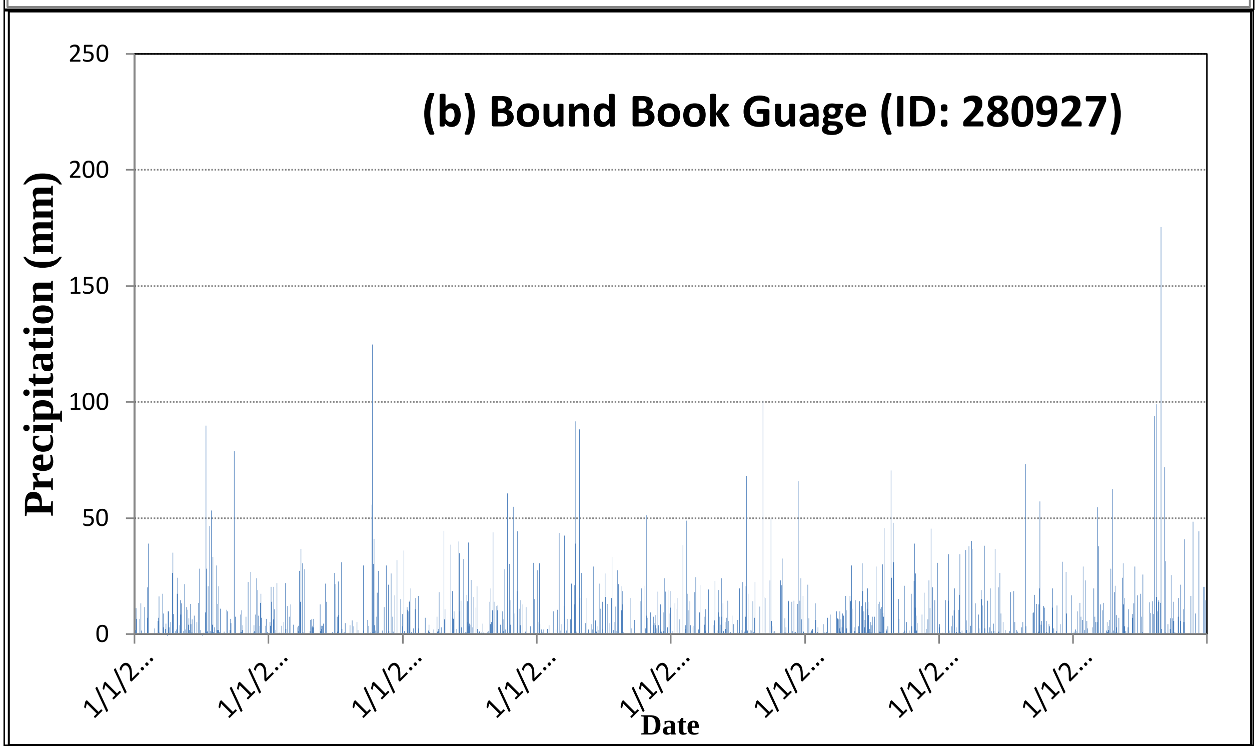


Figure 2.6: Time Series of Daily Precipitation (mm) from 2004-2011 at Plainfield and Bound Brook (NOAA) Gauges.

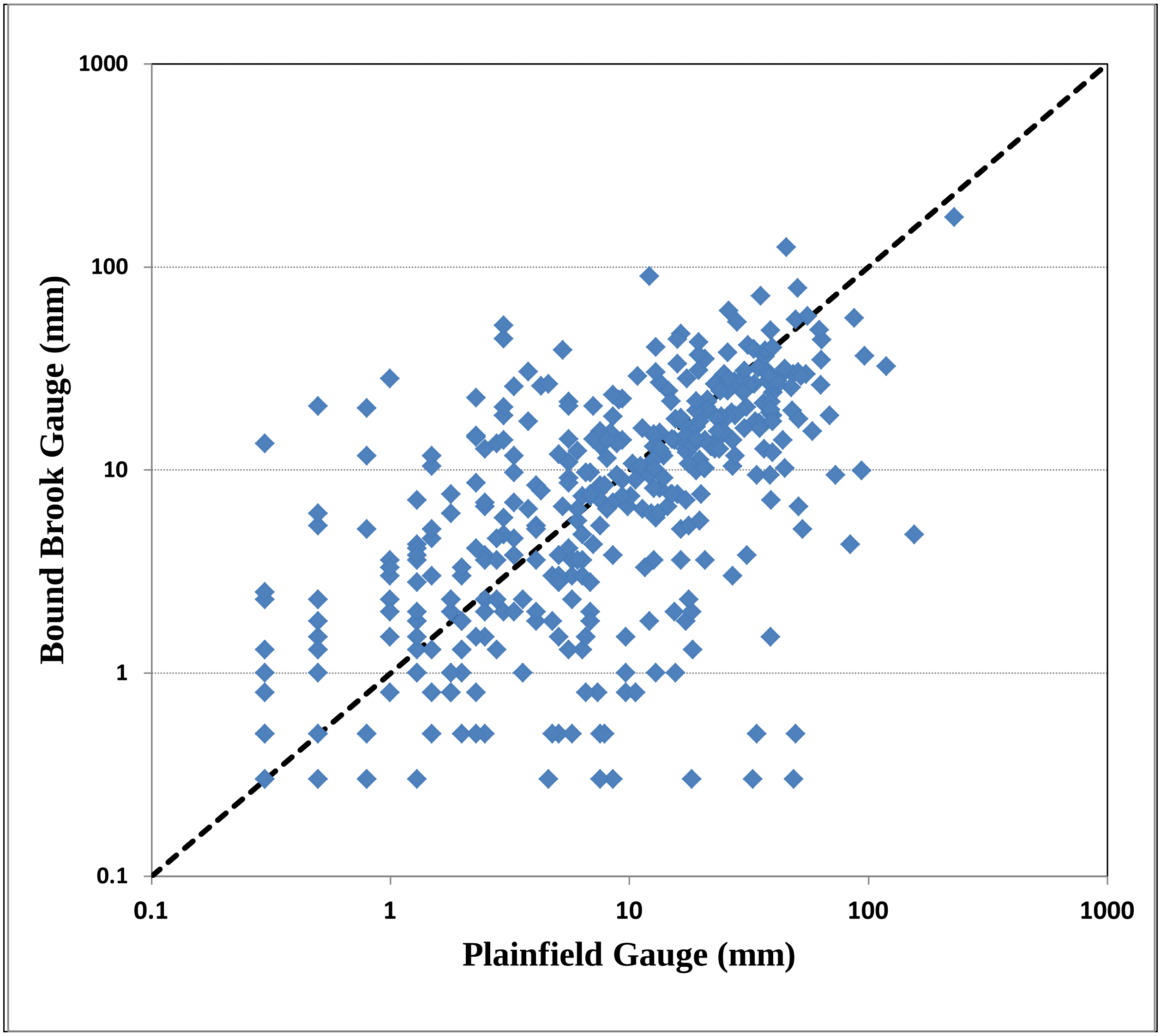


Figure 2.7: Scatter Plot (and Comparison) of Daily Precipitation (mm) recorded at Plainfield and Bound Brook Gauges.

2.4.5. Observed/Measured Flow Data

The calibration and validation of the entire Bound Brook/Green Brook SWAT watershed model were performed based on stream flow measurements at the USGS stream gauge at Middlesex, NJ (Gauge ID: 01403900; see Figure 2.1). A time series of daily flows measured at this station is presented in Figure 2.8 which indicates that the maximum stream flow of 4,440 cfs was observed on the 8/28/2011 (Hurricane Irene) when the maximum precipitation was also recorded by the precipitation gauges. However, other peaks in stream flow on 3/14/2010 (3,500 cfs) and 4/16/2007 (4,240 cfs) are not coincident with the corresponding peaks in precipitation. These differences in precipitation and observed stream flows contribute to the uncertainties in the simulation of watershed surface runoff and sediments yield.

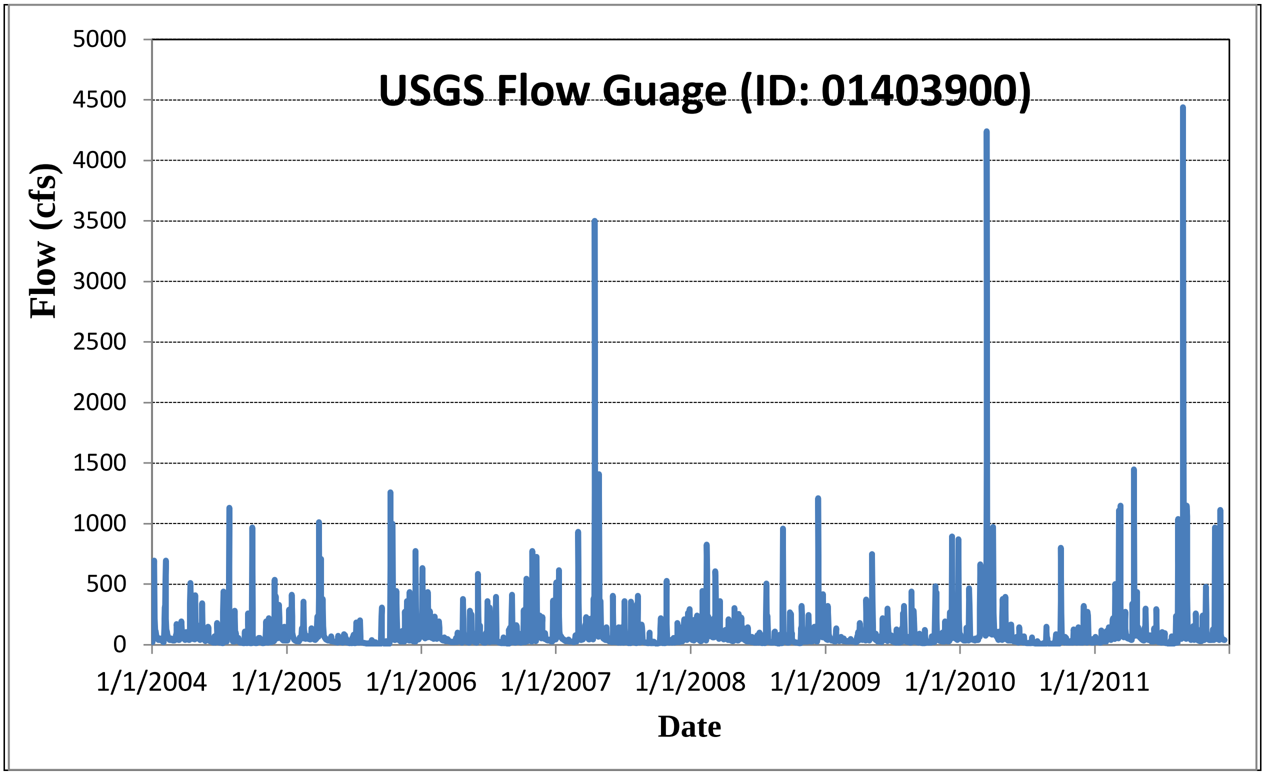


Figure 2.8: Time series of flow (cfs) at USGS Stream Gauge (ID: 0143900)

2.4.6. Observed Suspended Solids and Sediment Load rating Curve

At the USGS Gauge station (ID: 0143900), there are discrete data collected once of month for water quality. Paired suspended solids concentrations and corresponding flows (Figure 2.9) show a general increase in concentration at higher flows. Most of the available data were collected at flows less than 1200 cfs. Notably, there is a single observation at a flow of 2,800 cfs, for which the suspended solids concentration was reported at 65 mg/L. This low suspended solids concentration at such a high flow might indicate that suspended solids can be depleted during a flood event. (This point is not considered an outlier and was maintained in the analysis).

In general, a rainstorm causes an increase in discharge, erosion and transport of soil particles from the watershed into its streams, and an associated increase in turbulence in the stream. Within the stream, this turbulence re-suspends bed sediment and together with the sediment transported from the watershed soils, can result in high concentrations of suspension solids in the water. During prolonged rainstorms, discharge and turbulence may remain high but there is usually a progressive decline in the quantity of suspended material present in the water. This is because the quantity of sediment on a river bed, and which is introduced into the river by erosional processes, is limited and the amount of sediment available to be taken into suspension gradually diminishes during a storm event. These observations typically manifests when a series of discharge measurements and water samples are taken at intervals throughout a storm event (when flow increases, reaches a peak, and then decreases), in the form of a loop called a hysteresis loop (Ongley, 1996). Hysteresis may also be observed in plots of seasonal data. This reflects periods of the year when sediment may be more readily available than at other times. Higher TSS concentrations may occur, for example, after a long, dry period or in dry months when vegetation is not able to hold back soil particles that are being eroded.

Using the discrete suspended solids and flow data, a sediment rating curve was developed (Figure 2.10). The most commonly used sediment rating curve is an empirical power function that relates sediment concentration or sediment load (the product of concentration and flow) to flow (Asselman, 1999; Rondeau, 2000). In this study this relationship was derived by performing a log-log regression in log of the sediment load versus log of flow and a strong relationship (R^2 = 0.89) was obtained. Because the regression was performed in log units, any prediction of load at a particular level of flow will be equivalent to a median load. In addition to the median regression line, the 95 percent prediction interval (PI) is also included in the plots. The PI is the confidence interval for prediction of an estimate of an individual load for a corresponding flow value at which the load estimate is required. The PI incorporates the unexplained variability of sediment load in addition to uncertainties in the regression parameter estimates. The sediment rating curve developed in this study was used to predict median daily loads of suspended sediments based on daily flows from 2005 to 2011, and their associated uncertainty. These median daily loads and uncertainty were compared to model estimates of sediment yield derived from SWAT. It is important to note that because the majority of the data are available for flows less than 1200 cfs, the rating curve prediction for flow higher than 1200 cfs is based on extrapolation of the regression function and subject to greater uncertainty. Furthermore, the regression function as assumes that as flow increases suspended solids load will increase without limit, as assumption that is problematic in hysteresis occurs. Despite these limitations, this rating curves provides a good basis for comparison to SWAT model results.

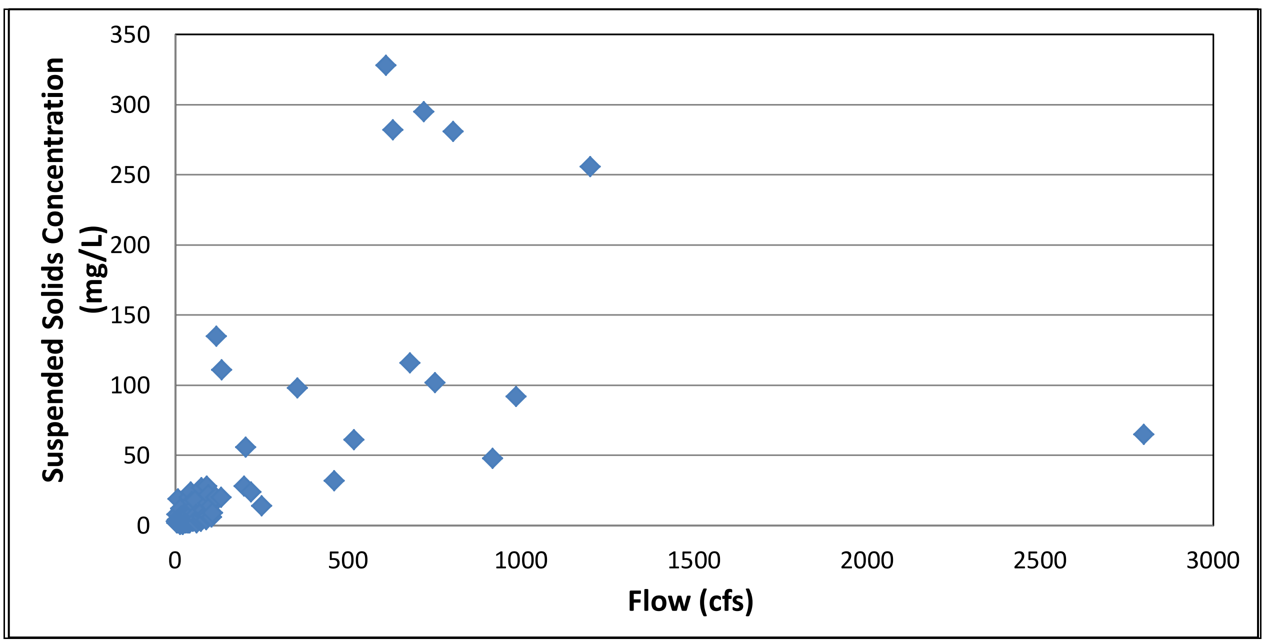


Figure 2-9: Suspended Solids concentration (mg/L) versus flow (cfs) at USGS Stream Gauge (ID: 0143900).

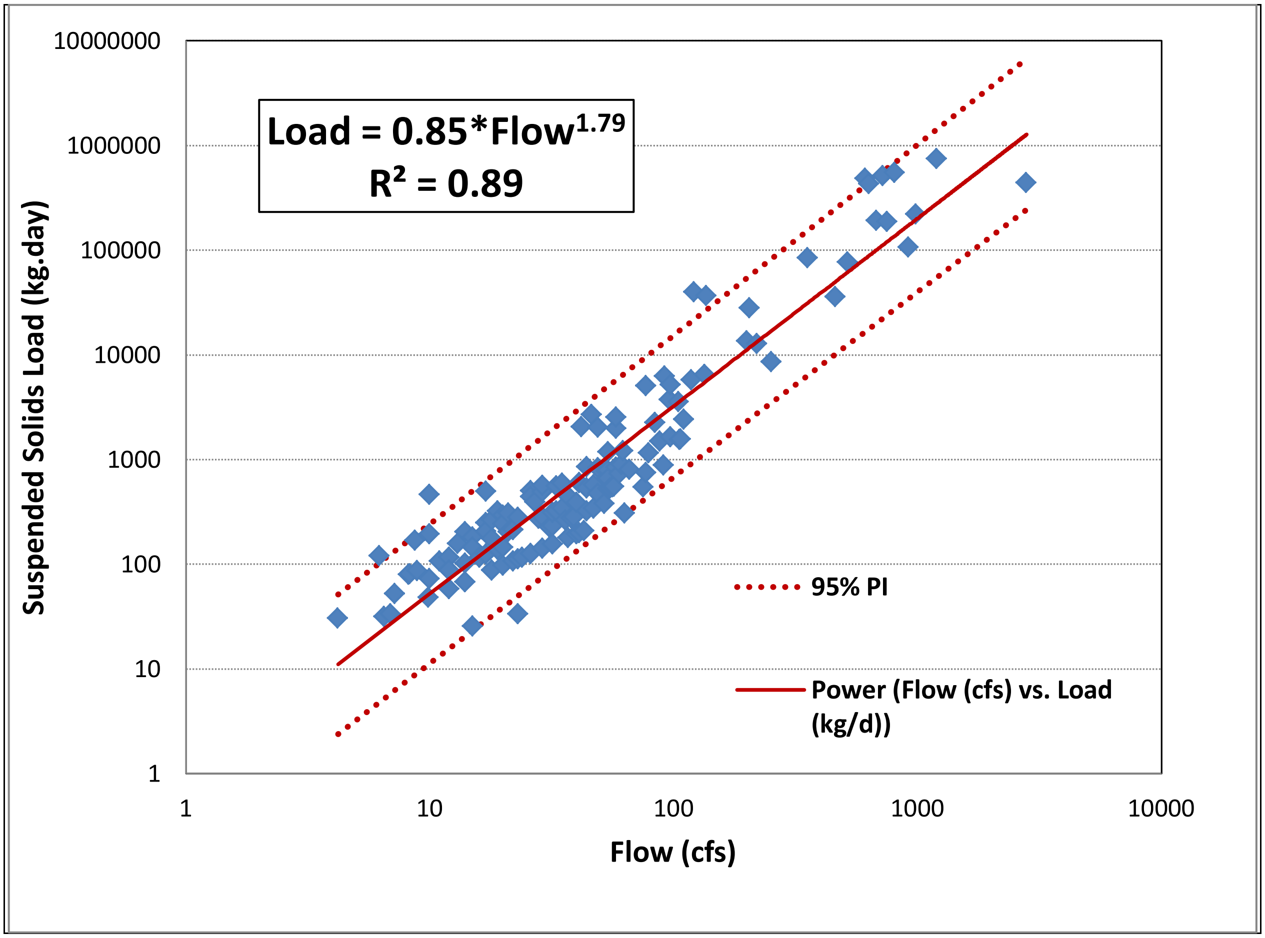


Figure 2.10: Sediment Rating Curve for USGS Stream Gauge (ID: 0143900) showing median prediction regression line and 95% prediction intervals.

2.5. Model Calibration for Flow

The SWAT model was run from 2004 to 2007. The year 2004 was used as the warm up period. Calibration was done from 2005 to 2007. Because SWAT's input parameters are physically based, they must be held within a realistic uncertainty range during calibration. The calibration procedure used in this study is consistent with the application of SWAT CUP outlined in Arnold *et. al.*, (2012) as follows:

- Develop initial or default SWAT input parameters (as created by ArcSWAT) and prepare the input files for SWAT-CUP.
- Run the SWAT model with initial parameters and plot the simulated and observed variables at each gauging station for the entire period of record.
- Determine the most sensitive parameters for the observed values of interest.

- Assign an initial uncertain range to each parameter globally, by scaling the parameters identically for each HRU.
- Run the SWAT-CUP-SUFI2 model several times and view the results for the gauged outlet.
- Perform the global sensitivity analysis and use the statistical output to eliminate non-sensitive parameters from the calibration process.
- Evaluate model performance.

The model performance of the calibration was evaluated qualitatively based on visual comparison of the monthly observed flows and the model simulated values, and quantitatively by the Nash-Sutcliff Index (NSE), and the coefficient of determination (R^2). The NSE indicates how well the plot of observed versus simulated data fits the 1:1 line. NSE is computed as:

$$NSE = 1 - \frac{\sum(O-S)^2}{\sum(O-\bar{O})^2}$$

Where, O and S are observed and simulated values, respectively. Ō is the mean observed values. NSE values range between -∞ and 1 with NSE of 1 indicating a perfect simulation. Simulation results are often considered to be satisfactory when NSE is greater than 0.5.

The coefficient of determination (R^2) is a measure of collinearity between observed and simulated data, and ranges between 0 and 1, is estimated as:

$$R^2 = \frac{[\sum(O-\bar{O})(S-\bar{S})]^2}{[\sum(O-\bar{O})^2][\sum(S-\bar{S})]^2}$$

Although $R^2 > 0.5$ is acceptable for modeling, a higher value is considered better. For this calibration, the model simulation was considered reasonable when both NSE and R^2 exceeded about 0.5.

Using the procedures outlined above for calibration using SWAT-CUP, a sensitivity analysis focusing on 12 parameters was conducted (Table 2.3). Based on the t-statistics and associated p-values, several of these parameters were determined to be sensitive parameters (p-value < 0.05). Although all 12 parameters were maintained during calibration, as SWAT cup randomly varied them between upper and lower bounds during 300 Monte-Carlo simulations to determine the best parameter fit. The range of values used during the calibration and the best parameter values are given in Table 2.4. The model calibrated flows using the best parameter values are shown in Figure 2.11. The high NSE and R^2 for the calibrated model simulation of 0.60 and 0.75 suggest that the calibrated model flows provides a good fit to the observed flows.

Table 2.3: Global Sensitivity Output for 12 Model Parameters

Parameter Name	Description	Process	t-Stat	P-Value
CN2	Curve number	Surface runoff	120.11	0.00
GW_REVAP	Revamp Coefficient	Groundwater	-11.86	0.00
SOL_BD(1)	Moist bulk density	Groundwater	-8.99	0.00
ESCO	Soil evaporation coefficient	Evapotranspiration	7.83	0.00
GW_DELAY	Groundwater delay time	Groundwater	-6.08	0.00
CH_N2	Manning's coefficient for main channel	Surface runoff	-5.21	0.00
GWQMN	Depth of water in shallow aquifer	Groundwater	-3.62	0.00
SOL_K(1)	Saturated hydraulic conductivity	Groundwater	3.24	0.00
ALPHA_BF	Base flow recession coefficient	Groundwater	2.51	0.01
SFTMP	Snowfall temperature	Snow	-1.37	0.17
ALPHA_BNK	Base flow alpha factor for bank storage	Groundwater	0.83	0.41
SOL_AWC(1)	Available water capacity	Groundwater, evaporation	-0.70	0.48

Table 2.4: Range of Values Used during the Calibration and the Best Parameter Values

Parameter Name	Units	Best Estimate	Lower Bound	Upper Bound
CN2	%	-0.49	-0.5	-0.2
ALPHA_BF	Days	0.74	0.0	1.0
GW_DELAY	Day	448	30	450
GWQMN	mm	0.64	0.0	2.0
GW_REVAP	-	0.15	0.0	0.2
ESCO	-	0.83	0.8	1.0
CH_N2	-	0.29	0.0	0.3
ALPHA_BNK	Days	0.28	0.0	1.0
SOL_AWC(1)	%	0.11	-0.2	0.4
SOL_K(1)	%	0.79	-0.8	0.8
SOL_BD(1)	%	-0.43	-0.5	0.6
SFTMP	^{o}C	1.35	-5.0	5.0

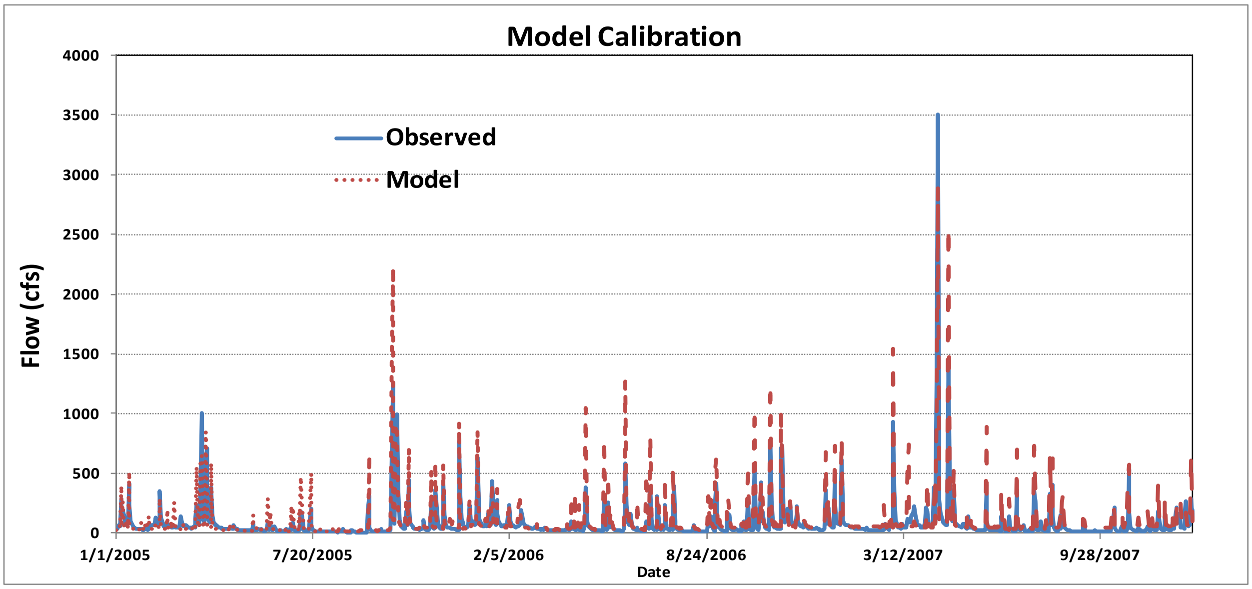


Figure 2.11: Observed daily flows and model best estimation at the USGS Gauging station during calibration period (2005 – 2007). Model fit: NS = 0.6; R^2 = 0.75.

2.6. Model Validation for Flow

The best estimated parameter values from the calibration were applied to simulate the validation period of 2008 – 2011. Figure 2.12 shows the model validation results. In general, the model shows a good fit (R^2 = 0.6) with the observed flows, although the NS of 0.3 was lower than the target of 0.5. The model over-predicts flows during storms, including flows for Hurricane Irene, which occurred in August 2011. It is important to note that uncertainties in model results are not only related to calibrated parameters, but also to uncertainties in other inputs like precipitation and temperature.

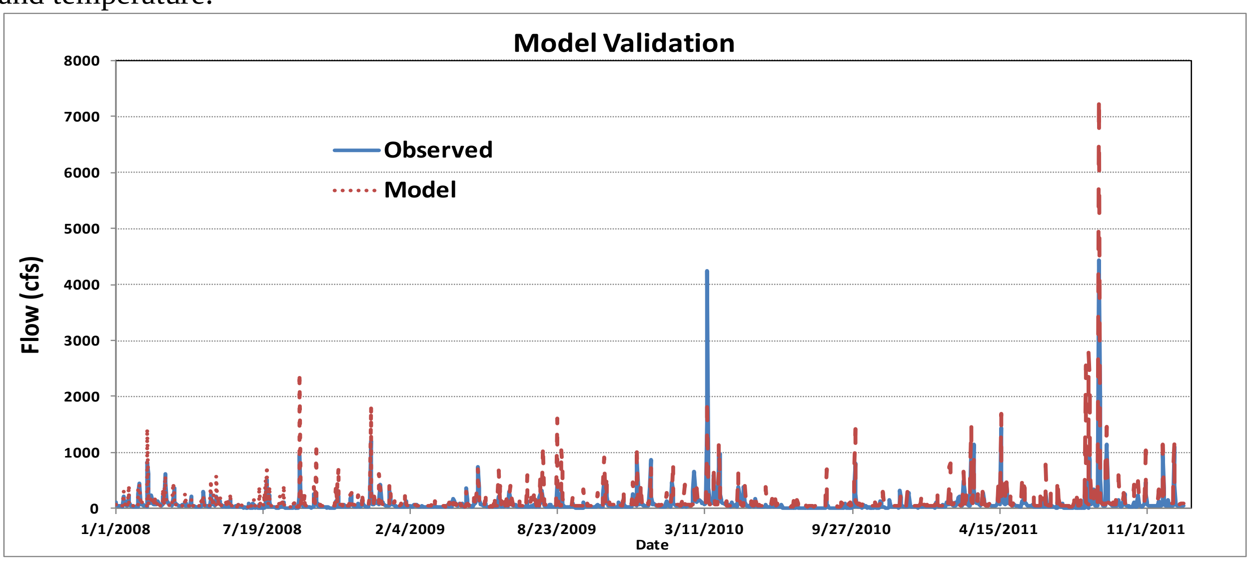


Figure 2.12: Observed daily flows and model best estimation at the USGS Gauging station during validation (2008-2011). Model fit: NS = 0.3; R^2 = 0.6.

2.7. Watershed Sediment Yield

The simulated sediment yield (based on Equation 2) was compared to values derived from the rating curve (described in Section 2.4.6 for the USGS Stream Gauge on a monthly basis),which was based on the observed TSS concentrations (Figure 2.13). In general, the simulated sediment yield was higher than the observed sediment yield during higher precipitation and runoff events. Although there is an observed difference between the two sediment yields, the model prediction generally falls within the 95 percent PI; consequently, the difference is not statistically significant. The sediment yield simulated by the model in various reaches and subbasins were saved and passed onto the SIAM model as described in Section 4.

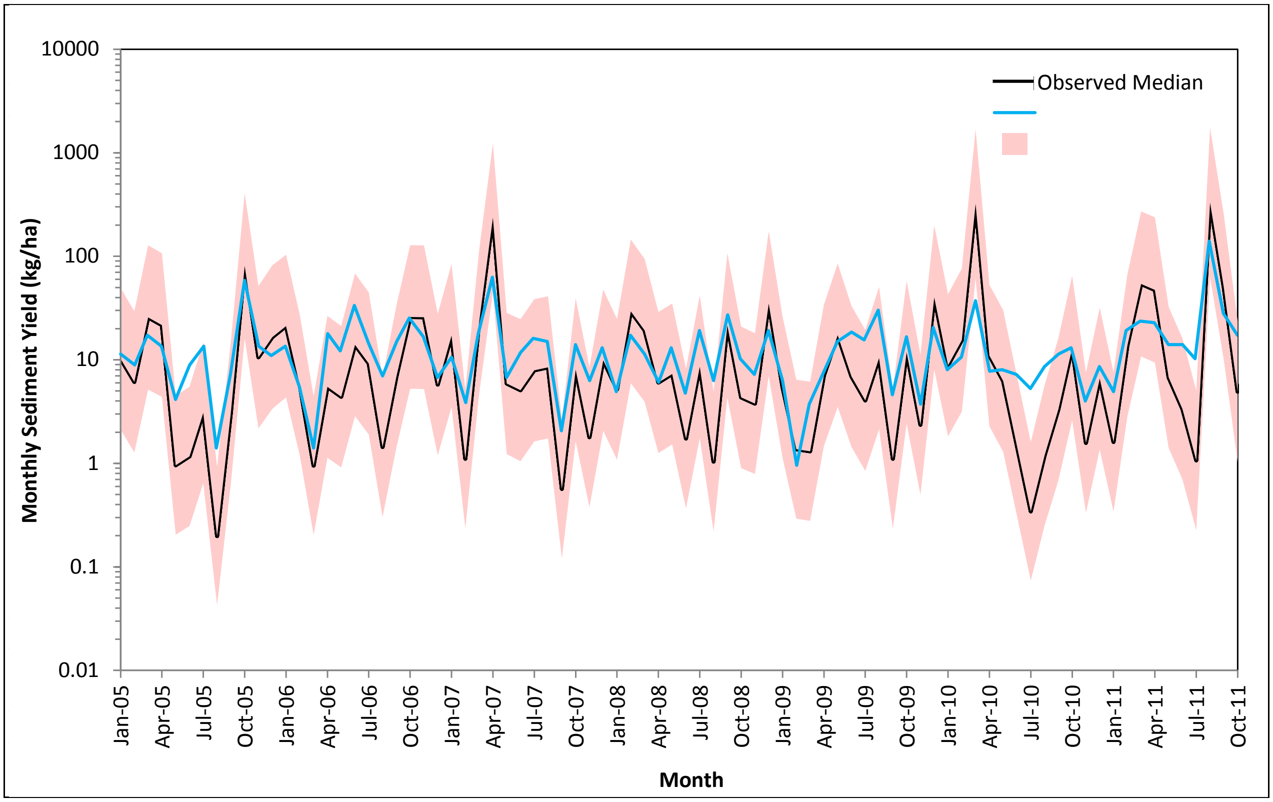


Figure 2.13: Comparison of Model Simulated Monthly Sediment yield (kg/ha) with Median Sediment Yield and 95 percent PI Derived from Rating Curve for USGS Stream Gauge (ID: 0143900).

3. Hydraulics Modeling

For stream hydraulics modeling, the Hydrologic Engineering Centers River Analysis System (HEC-RAS) was used. Hydrologic Engineering Centers River Analysis System (HEC-RAS) is a one-dimensional model, intended for hydraulic analysis of river channels. The model is comprised of a graphical user interface, separate hydraulic analysis components, data storage and management capabilities, graphics and reporting facilities. The HEC-RAS system includes four river analysis components. Based on the laws on conversation of energy, HEC-RAS model uses physical field measurements of the stream and floodplain cross sections to simulate flow related values including: flow rates, velocity, energy, and water surface elevation.

The main inputs to the model are:

- River geometric data: width, elevation, shape, location, length;
- River floodplain data: length, elevation;
- Manning roughness coefficient[3] (Manning 'n' values) for the landuse type covering the river and the floodplain area;
- Boundary conditions *e.g.* slope, critical depth; and,
- Stream discharge values from SWAT model runoff and stream routing result.

The outputs from the model include:

- Water surface elevations;
- Rating curves;
- Hydraulic properties, i.e., energy grade line slope and elevation, flow area, velocity; and,
- Visualization of stream flow, which shows the extent of flooding.

3.1. Channel-Geometry Data

Channel cross-section projections used in the Bound Brook HEC-RAS model were obtained from field surveys conducted by Pennoni Associates during the winter of 2011. All cross-sections were surveyed perpendicular to the channel. The cross-section projections included the channel, banks, and an extended 50 feet onto the floodplain. Maximum distance between adjacent surveyed points was limited to 10 feet so as to accurately survey elevation changes along cross sections. Throughout Bound Brook from RM0 at the confluence with Green Brook to RM7 at the upstream extent of the study area, all in-stream structures including culverts, bridges, spillways, and other features within the channel were field surveyed to obtain elevation

[3] Mannings roughness coefficient incorporates potential presence of debris material in the streambed in the model.

data and structural geometry. Bridge, spillway, and culvert cross-section data were collected at close intervals upstream and downstream of the structures in order to compute the potential backwater effects of these structures. In all, 45 cross sections (of channel and of structure) were surveyed in the winter of 2011 to define channel cross-section geometry for this sediment-transport study. Cross sections data for new Market Pond were obtained from drawings obtained from the township of Piscataway, NJ.

3.2. Floodplain - Contour Data

Pennoni Associates surveyed cross sections only extended 50 feet from both left and right stream bank stations and did not extend far enough to cover the entire floodplain to higher ground which is required for HEC-RAS model to accurately model high flow conditions. Beyond the limits of the site survey, the cross sections were supplemented with additional contours that were generated using the U.S. Geological Survey (USGS) National Elevation Dataset (NED) digital elevation models (DEM). The DEM is available online at the USGS National Map Seamless Server. The DEM used for this purpose has a resolution of 1/9 Arc-Second (approximately 9.84 ft). The DEM data unit was in meters with a geographic projection. It has a vertical datum of NAVD88 in meters and a horizontal projection of NAD83. The resolution of the data was approximately 3 meters with a vertical accuracy of +/- 1 meter. To accurately merge the surveyed data which has a New Jersey State plane coordinate and vertical datum of NAVD88 in feet, the USGS NED data was re-projected to New Jersey State Plane Coordinate with English units (feet). The DEM data were imported into ArcMap 10, and 0.5 meter (approx. 1.6 feet) contour intervals were generated using the Spatial Analyst and the 3D Analyst extensions in ArcGIS.

3.3. Stream Change Location - Flow Data

In order to simulate the entire Bound Brook stream and to check the simulated water surface elevations at certain locations, the use of “multiple flow change junctions” was needed. A stream flow change junction was added at any location where subwatershed runoff is added via a tributary or at a location where model simulated water surface elevations were to be compared against measured data. Overall, about nine flow change locations were identified for the hydraulic modeling as shown in Figure 3.1. This flow data fused for input into HEC-RAS was obtained from the daily flow data predicted by SWAT.

3.4. Manning n-values

The Manning’s n-value is used to help calculate the energy losses between cross sections due to friction. The Manning’s n-value depends on a number of factors which include: surface roughness (including debris), vegetation, channel irregularities, degree of meander, obstructions, size and shape of the channel. In this study, Manning’s n-values used in the hydraulic computations were assigned on the basis of engineering judgment, aerial photographs and field observations of the Brook and floodplain areas.

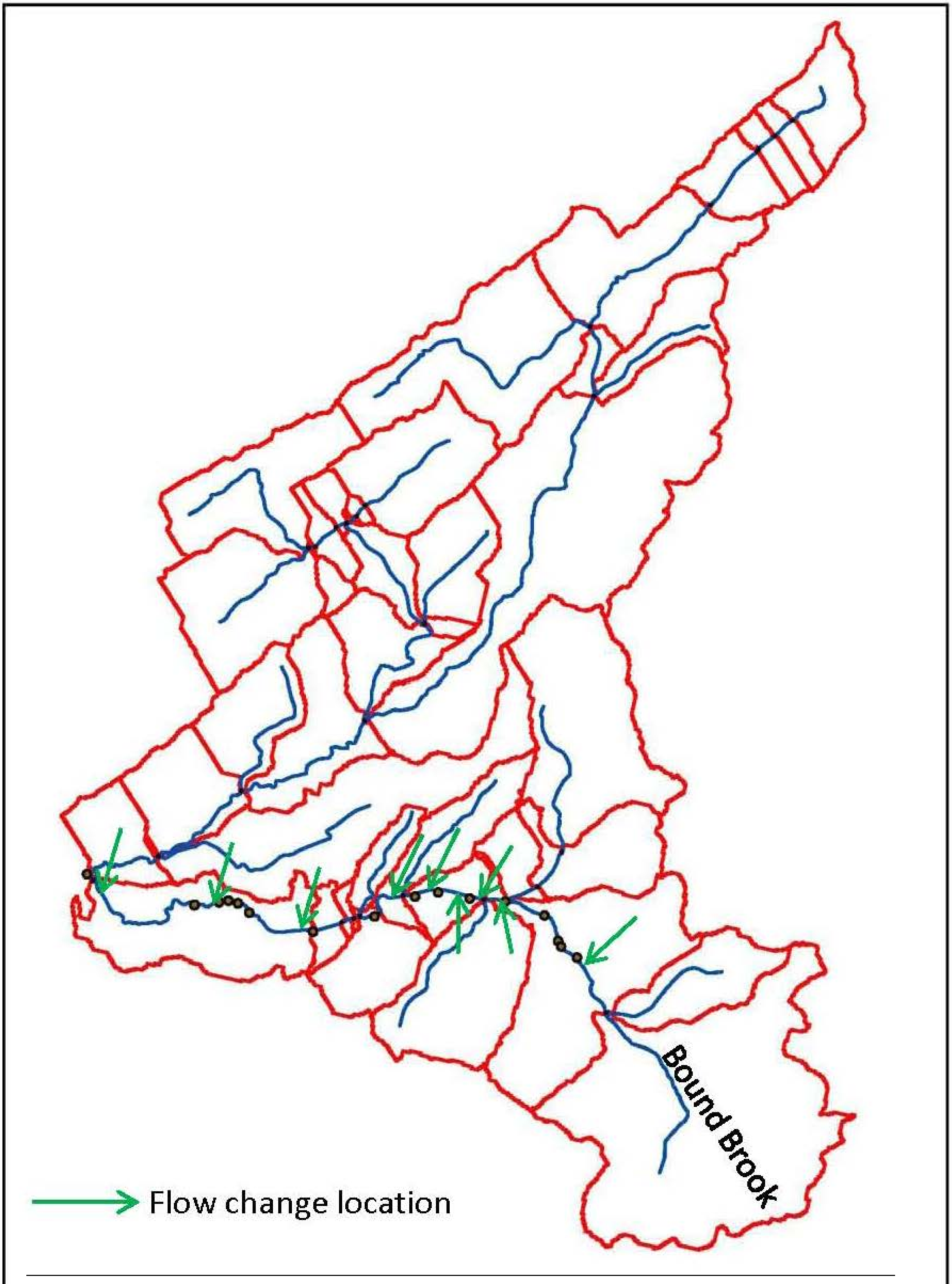


Figure 3.1: Flow change locations

Existing vegetation along the river banks has a substantial influence on hydraulic roughness and the influence varies according to depth and magnitude of flow. Different hydraulic roughness factors were therefore determined for the main channel of flow and the floodplain areas. Channel roughness values were generally low over the extent of the hydraulic model. The final Manning n-values assigned to the various sections were determined by calibration, but they ranged from 0.035 to 0.07 in the channel and from 0.02 to 0.1 on the floodplain.

3.5. Boundary Conditions

In HEC-RAS, boundary conditions are needed to establish the starting water elevation at the ends of Bound Brook study limits (upstream and downstream) and for the model to begin the calculations. For the Bound Brook HEC-RAS model, a mixed flow regime was assumed and for this flow regime, normal depth boundary conditions were used at both ends of the study limits. The normal depths for upstream and downstream boundary conditions were approximated by using the slope of bound Brook bed at those locations respectively.

3.6. Calibration of HEC-RAS Model

The HEC-RAS model was calibrated by adjusting the Manning's roughness coefficient within acceptable limits, to better match the model computed surface water elevation to The Louis Berger Group, Inc., (LBG) field measured surface water elevations. This calibration approach was chosen because roughness parameter together with geometry is considered to have the most important impact on predicting inundation extent and flow characteristics (Aronica *et. al.*, 1998; Bates *et. al.*, 1996; Hankin and Beven, 1998; Hardy *et. al.*, 1999; Rameshwaran and Willetts, 1999; Romanowicz *et. al.*, 1996).

LBG installed eight Solinst level loggers at strategic locations in the Brook within the study area, in 2011, to continuously measure surface water levels that were meant to be used for model calibration and other analysis. Figure 3.1 show the LBG Solinst level logger locations. Only the six level loggers in the main channel were used in the calibration including: Belmont Avenue, Clinton Avenue, South Avenue, Bound Brook Road bridges, manmade dam and New Market Pond.

A comparison of the observed versus simulated water surface elevations are shown in Figures 3.2 through 3.7. As shown in Figures 3.2 through 3.7, the simulated surface water elevations closely match the observed elevations with the exception of the Manmade Dam and South Avenue Bridge locations where there is a vertical shift between observed and simulated water surface elevations. The vertical shift for these two locations appears to be constant and is likely a result of error in recording the level-logger tether length, which is used in converting measured water depth to water elevation.

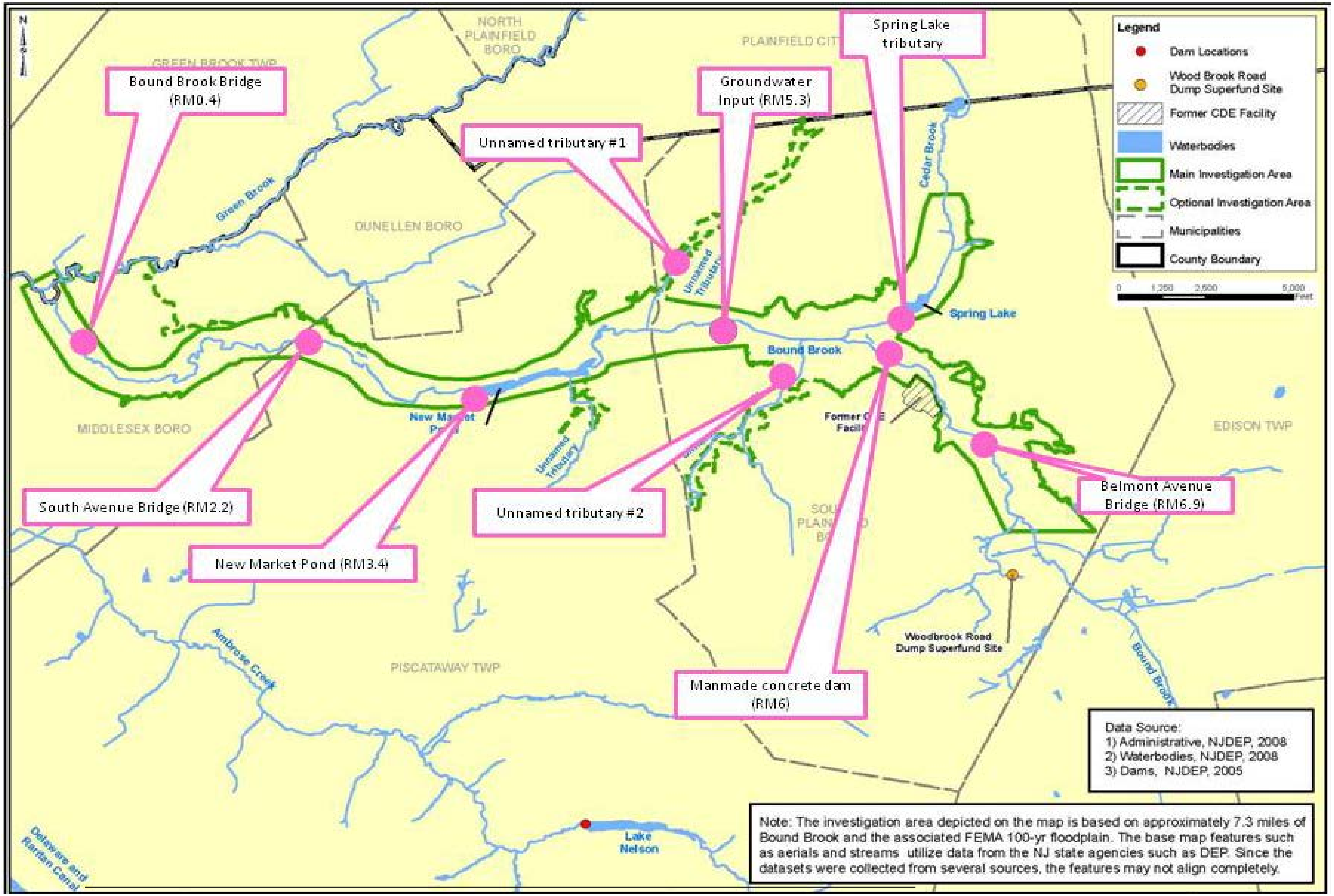


Figure 3-2. Continuous water level measuring locations

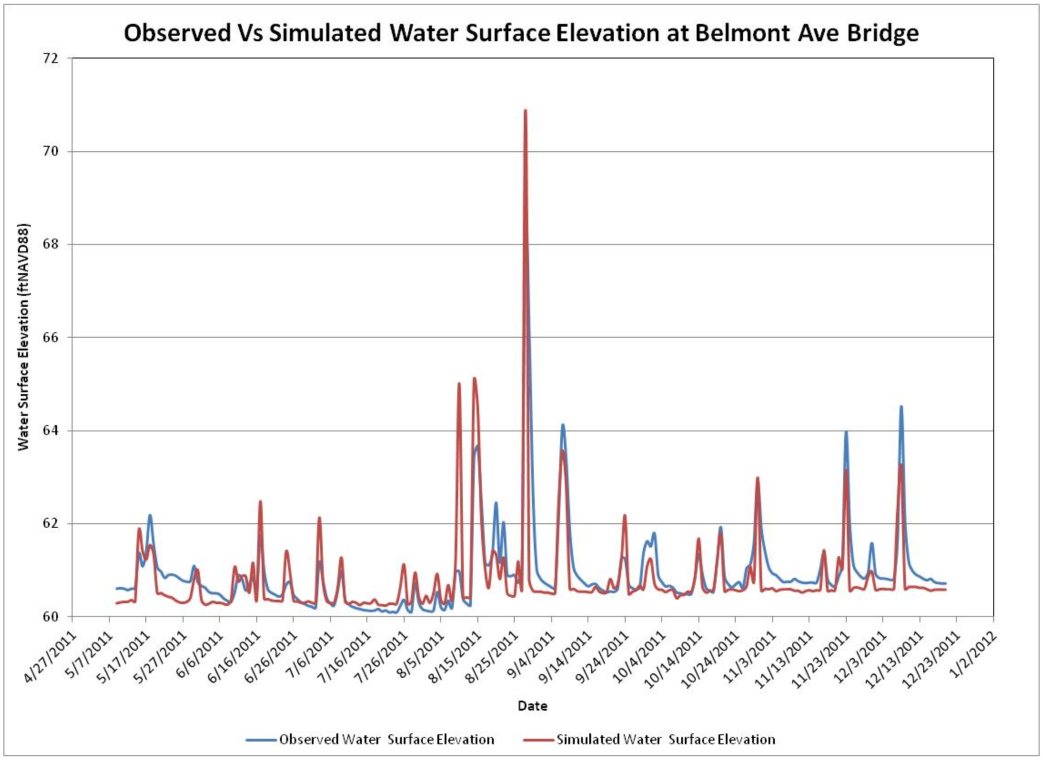


Figure 3.3: Observed versus simulated water surface elevation at Belmont Avenue Bridge

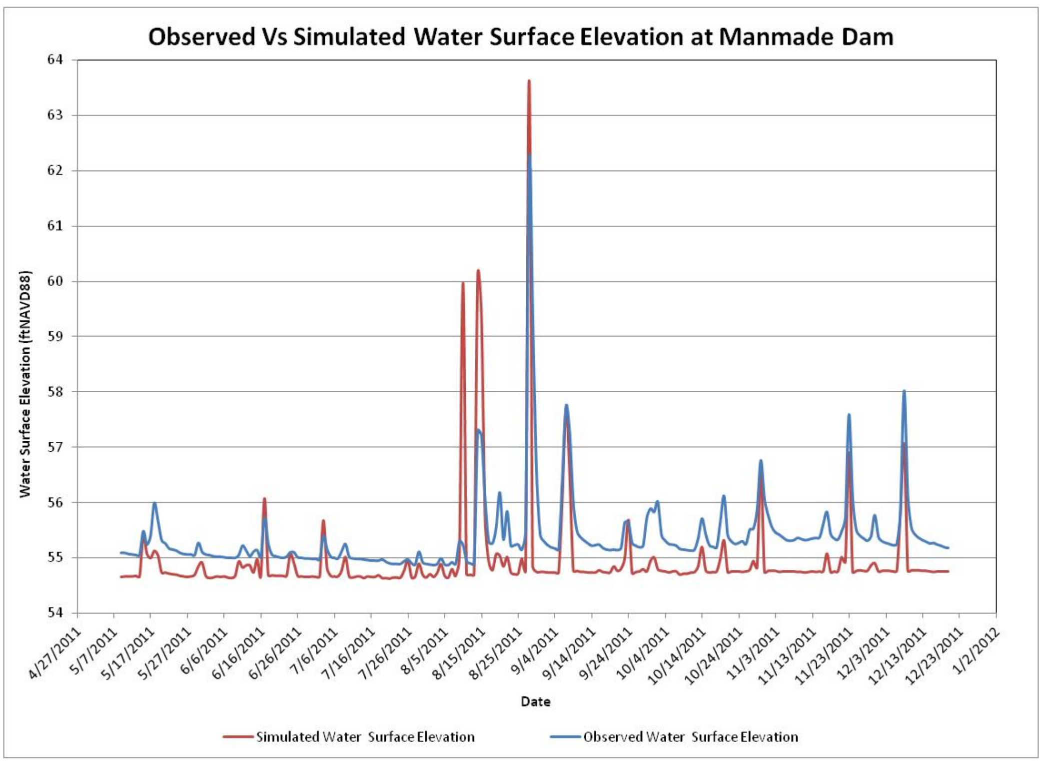


Figure 3.4: Observed versus simulated water surface elevation at Manmade Dam

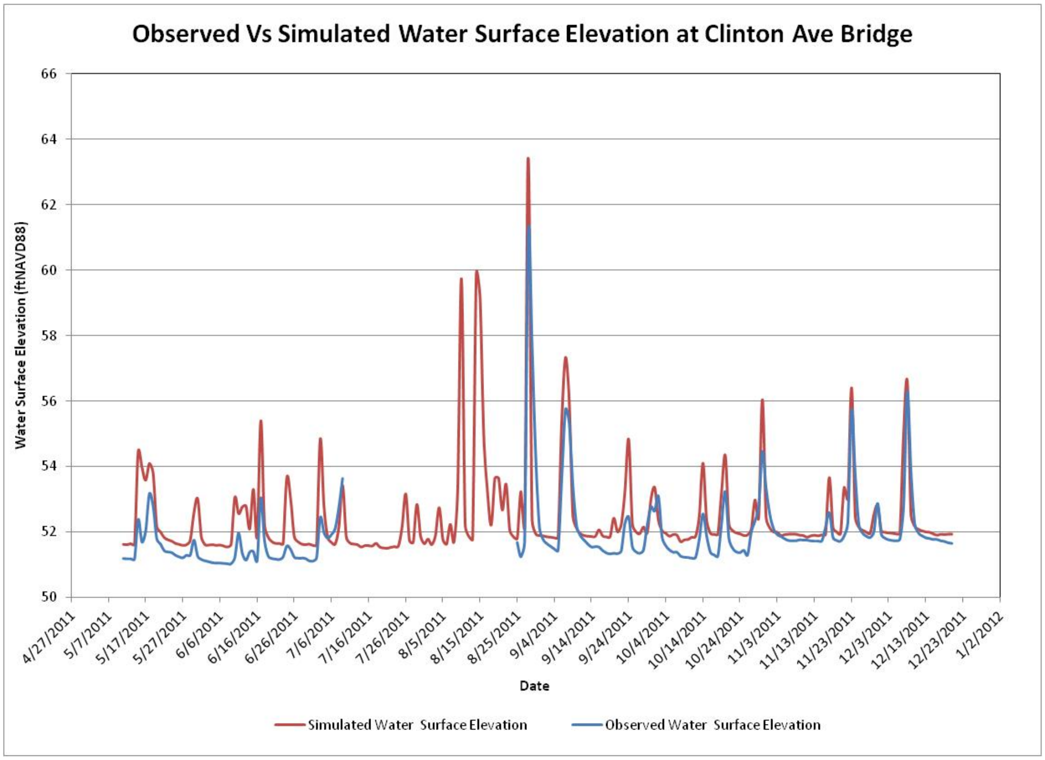


Figure 3.5: Observed versus simulated water surface elevation at Clinton Avenue Bridge

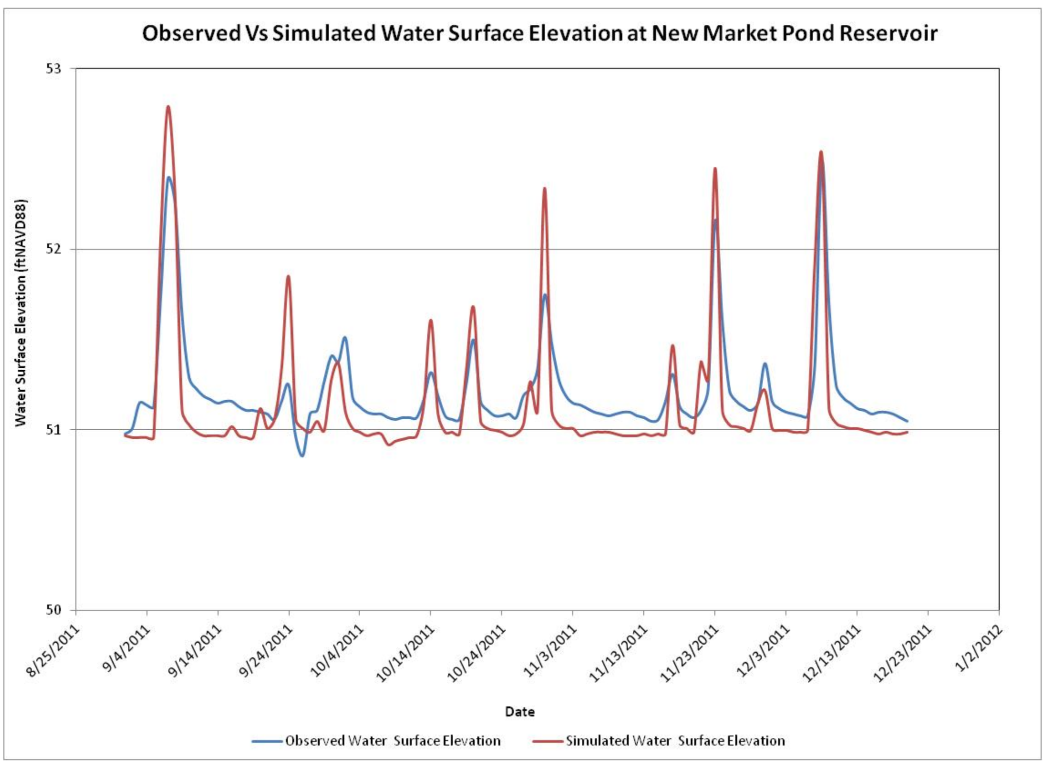


Figure 3.6: Observed versus simulated water surface elevation at New Market Pond Reservoir

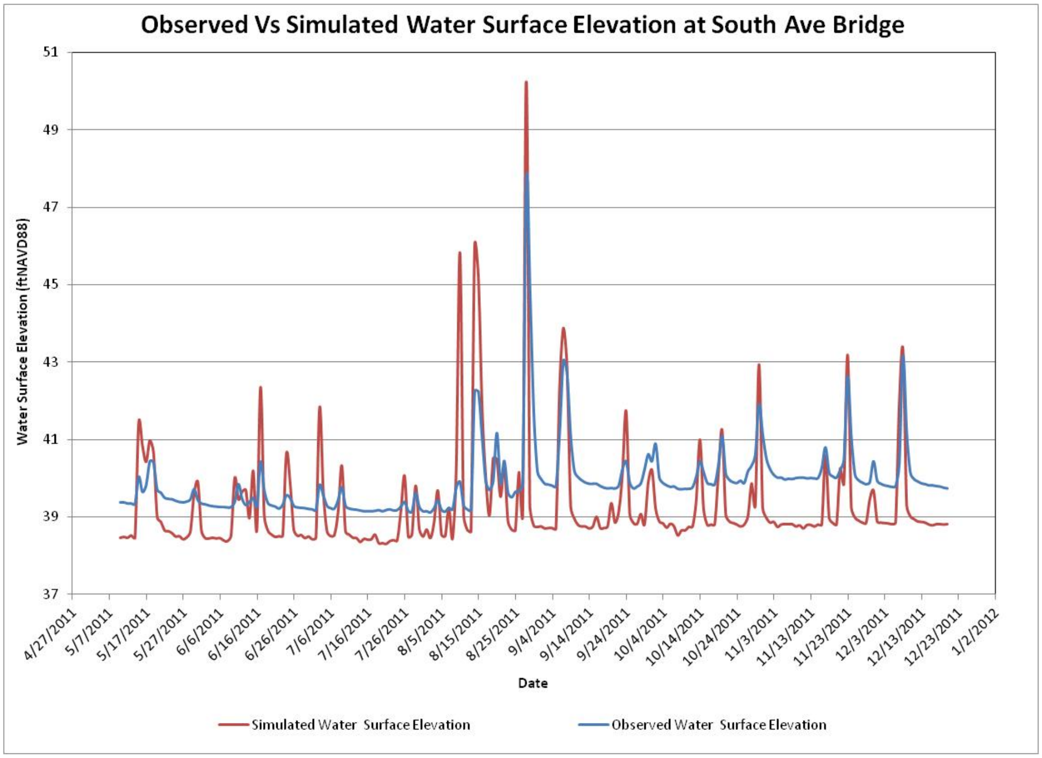


Figure 3-7: Observed versus simulated water surface elevation at South Avenue Bridge

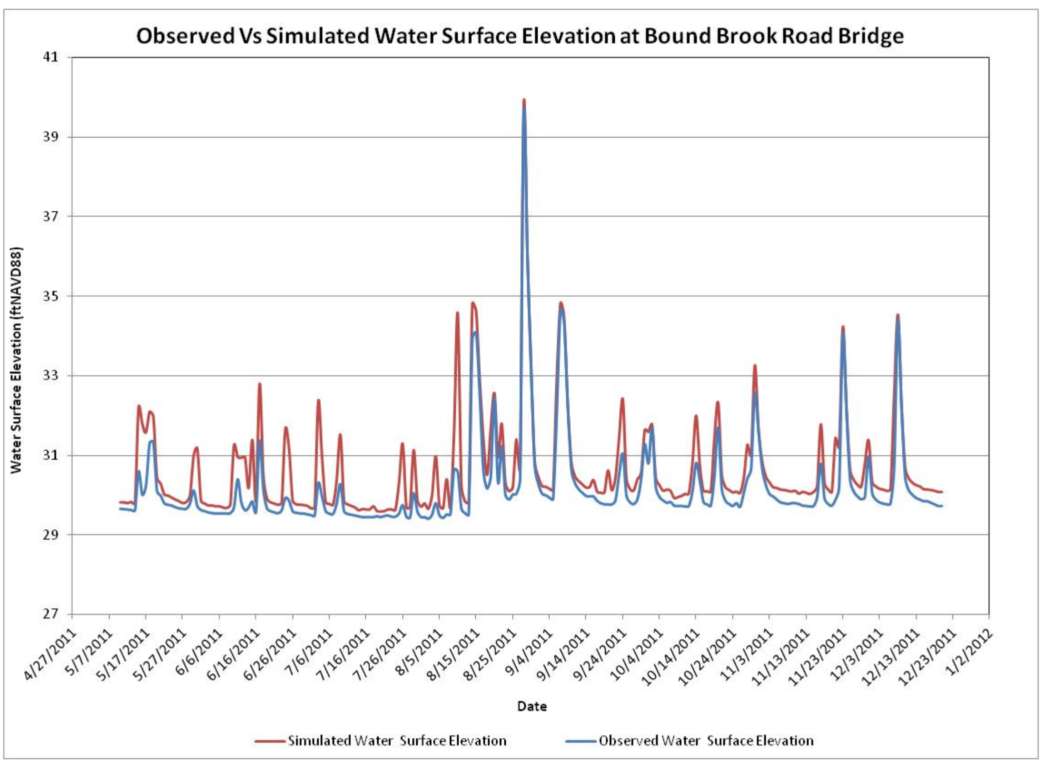


Figure 3.8: Observed versus simulated water surface elevation at Bound Brook Road Bridge

4. Sediment Delivery Analysis – Base Case and FS Scenarios

A sediment assessment model constructed using SIAM feature in HEC-RAS was used to evaluate potential changes in sedimentation patterns that could occur due to remedial alternatives assessed as part of the feasibility studies. SIAM compares the annual sediment transport capacity of a river reach to the annual sediment supply and provides an indication of whether aggradations, degradation, or equilibrium may occur. Initially, a steady-state HEC-RAS model was developed and the hydraulic results were used in the SIAM for analyses. Since HEC-RAS/SIAM model runs under quasi-steady-state condition, the 2005-2011 SWAT model-computed flows were transformed to annualized flow duration values (see Section 4.2.1 for details). Each flow level required for SIAM was modeled in HEC-RAS and the steady state hydraulic results were passed onto SIAM. A schematic showing the sediment balance algorithm in SIAM is provided in Figure 4-1.

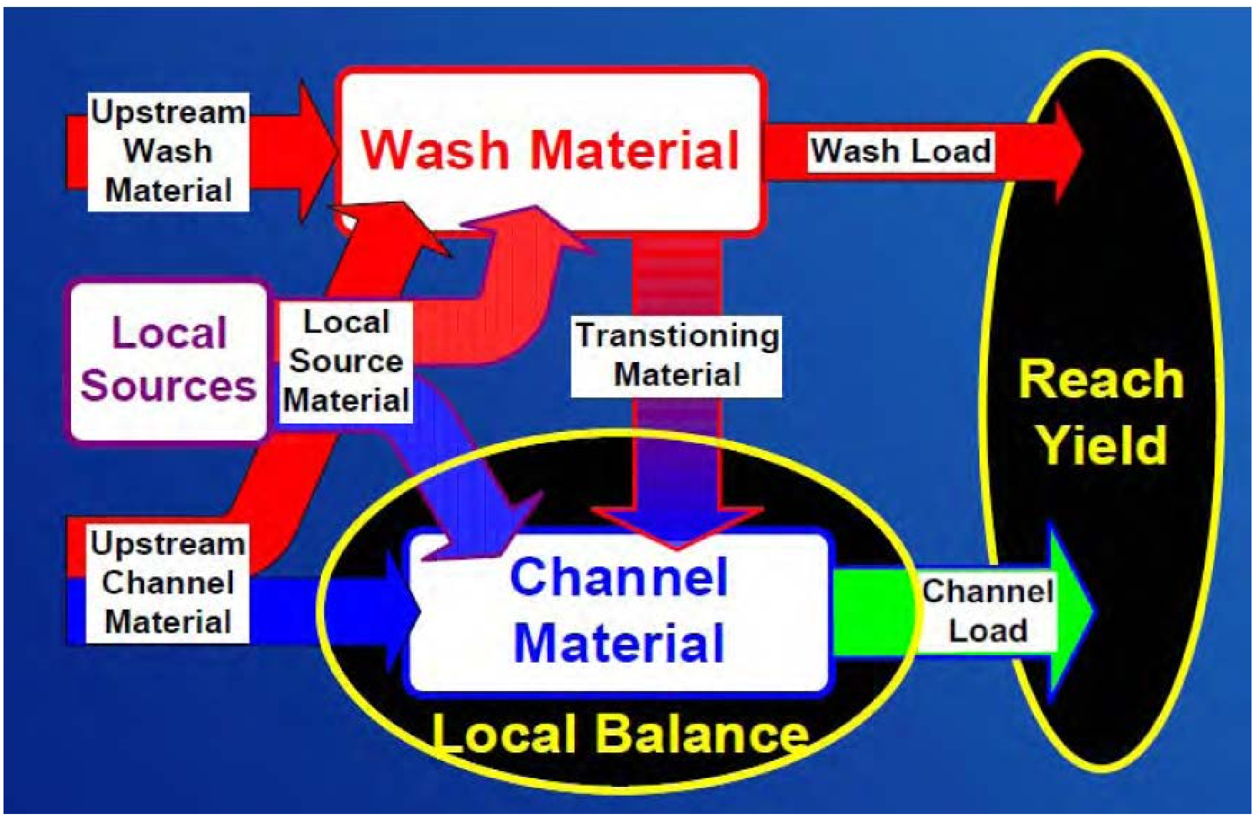


Figure 4-1: SIAM Sediment Balance Schematic (FTER Mooney, 2006)

The SIAM feature was applied for all reaches in Bound brook from just above Belmont Avenue Bridge (RM6.87) to its confluence with Green Brook (RM0) for the following scenarios:

- Base Case - This is the current conditions
- Scenario 1 - Assessment of impact of removing twin culverts on sediment deposition
- Scenario 2 - Assessment the impact of sediment deposition by constructing a dam just upstream of Lakeview Ave between Lakeview Ave and the twin culverts at approximately RM6.2.
- Scenario 3 – Removal of the man-made dam at RM6.0.

4.1. SIAM Sediment Reaches

The first step in SIAM is to subdivide the stream in the HEC-RAS hydraulic model into sediment reaches, which represent the scale at which sediment transport calculations are performed. A sediment reach is defined as a grouping of stream cross-sections with relatively consistent hydraulic and sediment properties, and recognizing any significant geomorphic changes in channel gradient, channel geometry, and sediment composition. Based on these parameters and field observations of sediment texture, Bound Brook was subdivided into fourteen sediment reaches as shown in Figure 4-2. Note that Reach 4 was further subdivided into 4a, 4b and 4c to allow for physical changes to be made for simulation of different restoration/remedial alternatives in SIAM. The river mile boundaries of these reaches are given in Table 4.1.

Table 4.1: Bound Brook SIAM sediment reaches and description of sediment bed gradation

Sediment Reach	River Mile		Bed Gradation
	Upstream Extent	Downstream Extent	
1	6.87	6.64	Mostly sand
2	6.64	6.57	Mostly clay
3*	6.57	6.23[3]	Mostly sand
4a	6.23	6.17	Mostly fine sand
4b**	6.17	6.00[2]	Mostly fine sand
4c	6.00	5.77	Mostly fine sand
5	5.77	5.39	Mostly fine sand
6	5.39	5.04	Mixture of clay silt and sand
7	5.04	4.78	Mostly sand with some silt and clay
8	4.78	4.10	Mostly sand with silt clay mixture
9***	4.10	3.42[1]	Mostly clay and silt with some sand
10	3.42	2.56	Clay, silt sand and some gravel
11	2.56	2.39	Clay, silt sand and some gravel
12	2.39	2.18	Mostly fine to medium sand
13	2.18	1.87	Mostly medium to coarse Gravel

Sediment Reach	River Mile		Bed Gradation
	Upstream Extent	Downstream Extent	
14	1.87	0.00	Mostly fine to medium sand

* Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
** Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
*** New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

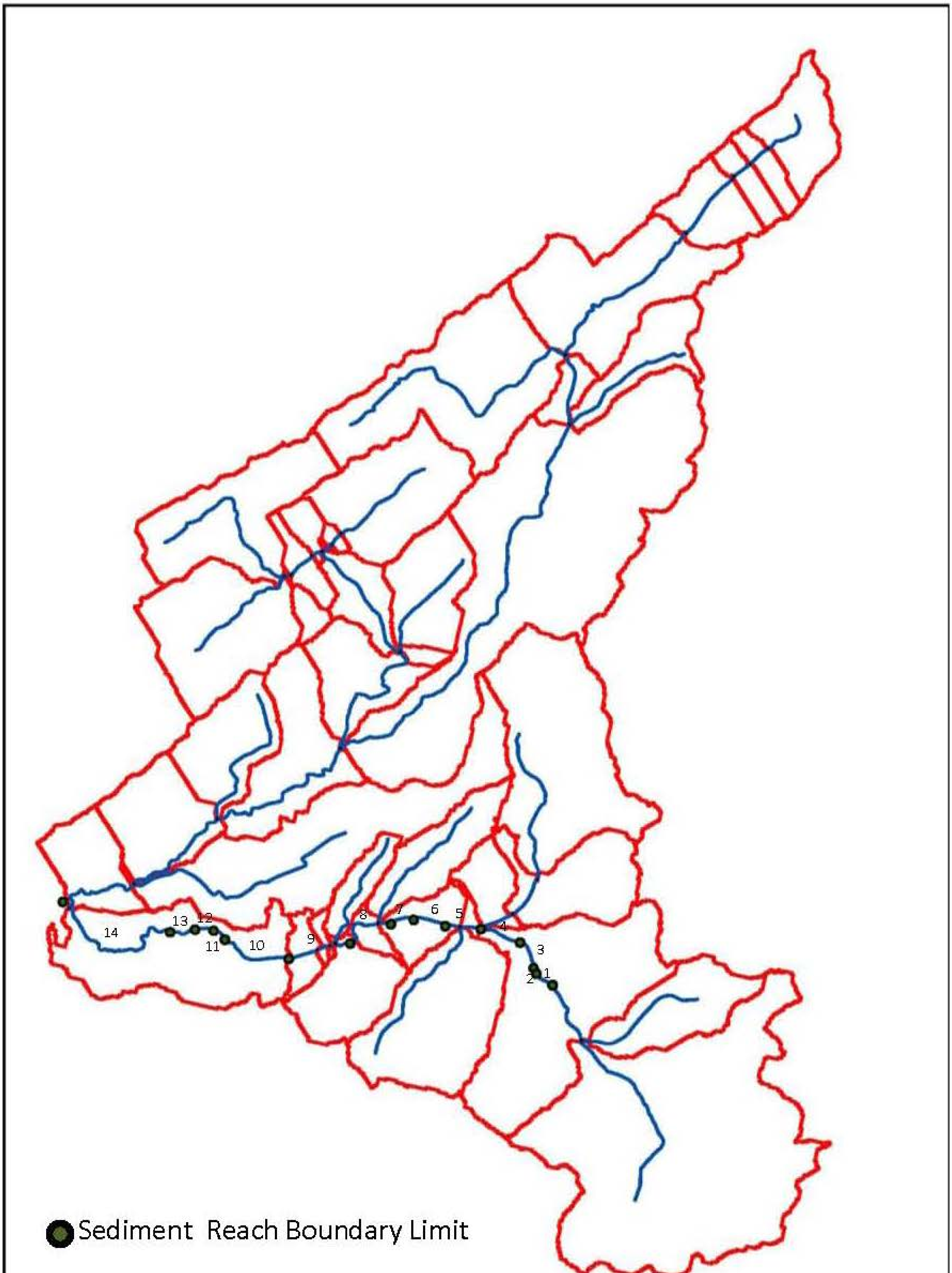


Figure 4-2: Bound Brook SIAM sediment reaches (river miles for each "reach" are provided in Table 4-1)

4.2. SIAM Input Data

The input required for the SIAM module includes cross section data for the study reach, annualized discharge-duration data, bed material gradations, an appropriate sediment transport function, wash load criteria, and annualized sediment input volumes (broken down by grain size fractions). The SIAM modeling was conducted using the calibrated HEC-RAS bank full model that created the elevation-duration curves described in Section 3.

4.2.1. Annualized Discharge Duration

Sediment transport estimates developed by SIAM are based on annualized flow-duration curves created from mean daily discharges. The flow-duration curves used in the SIAM simulations were based on the results of the SWAT simulated stream flow for the period 2005 to 2011 presented in Section 2. For each loading point, the minimum and maximum discharge for the period 2005-2011 was determined, and the resulting range of discharge was divided into 36 bins. There is no guidance on the optimal number of bins to use for the annualized flow-duration curve and review of SIAM applications at other sites indicates that as low as 9 bins to more than 40 bins have been used. The daily discharges simulated by SWAT for each reach were evaluated to determine the number of days that discharge occurred in each bin, and the average annual duration in days was determined for the representative flow of each bin. Table 4.2 shows the discharges simulated at RM0 and corresponding SIAM input duration in days. The total duration must equal 365 days because SIAM predicts annual trends. The discharge at other loading points was analyzed similarly. Each discharge was modeled by in HEC-RAS, and the corresponding average annual days were entered in the SIAM hydro data table for each reach.

Table 4.2: SIAM Flow duration at Downstream Boundary RM0

Discharge (cfs)	Duration (days)	Discharge (cfs)	Duration (days)
7.90	3.44	60.61	7.31
9.53	7.31	74.69	7.31
11.67	7.31	96.09	7.31
14.88	18.21	115.64	3.59
18.03	18.21	127.88	3.73
19.58	18.21	141.47	3.59
21.62	36.57	153.17	3.73
24.35	36.57	166.66	3.59
25.95	18.64	189.86	3.59
26.80	17.93	228.57	3.73
27.39	18.36	266.86	3.59
28.33	18.07	333.37	3.73

Discharge (cfs)	Duration (days)	Discharge (cfs)	Duration (days)
29.30	18.36	400.95	3.59
30.57	18.07	485.91	2.58
35.10	18.36	614.53	1.86
40.10	7.46	821.84	1.43
44.58	10.76	1336.73	1.43
52.07	7.31	4050.59	0.14

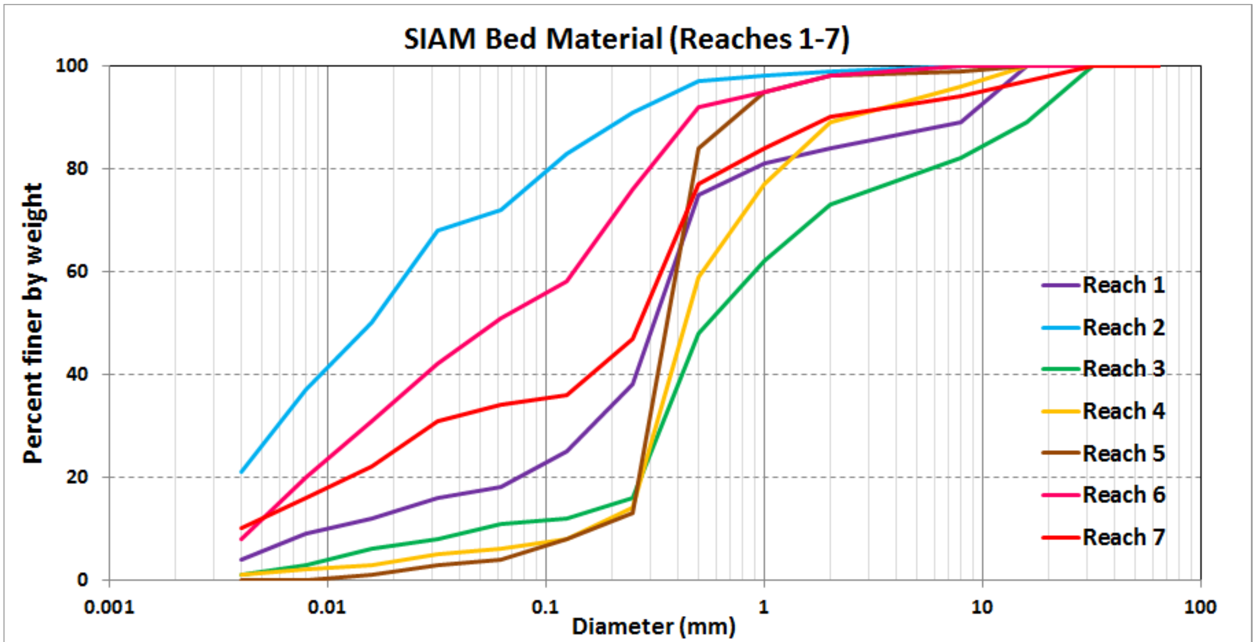
4.2.2. Bed Material

Bed material gradations associated with each SIAM sediment reach were determined from low-resolution coring grain size analysis collected during the RI field investigations. For each SIAM sediment reach, the representative grain size distribution was determined based on the predominant sediment texture characteristics reported in the sediment probing field survey during the RI. The bed material gradations used for the SIAM sediment reaches (Figure 4.3) were entered into HEC-RAS as the percent of the total sediment gradation finer than a particular sediment class particle diameter by weight.

4.2.3. Sediment Transport Properties

The sediment transport properties input data for SIAM describe the selected sediment transport function, the particle fall velocity, and the wash load threshold diameter. SIAM includes six different functions to compute sediment transport capacity over a range of bed material sizes, including: Ackers-White, Engelund-Hansen, Laursen-Copeland, Meyer-Peter Müller, Toffaleti, and Yang. The bed material in Bound Brook varies greatly ranging from coarse sand to clay. Of the six available transport functions in SIAM, all but Laursen-Copeland were developed from data based on sand or larger sized particles, making them poor choices for this analysis. The Laursen-Copeland sediment transport function, which was developed for material sizes that extend to the range of coarse silt, finer silts and clay size particles, was selected for all SIAM sediment reaches. Particle fall velocity was set to the default values for the Laursen-Copeland transport function.

The maximum wash load threshold is also required in SIAM. Wash load is defined as sediment in transport and it is generally derived from sources other than the bed (Biedenharn *et. al.*, 2006). SIAM does not apply standard transport equations to compute a mass balance for wash load material (USACE, 2010a,b). Instead, the program automatically passes any particle equal to or smaller than the maximum wash load through the system. Although there is no universally accepted method of selecting a wash load threshold, the material is often considered the fine-sized silt and clay material (particles less than 0.0625 mm in diameter). Einstein (1950) defined wash load as the grain size of which 10 percent of the bed mixture is finer. In this analysis, the wash load threshold diameter was set as 0.004 mm for all reaches.



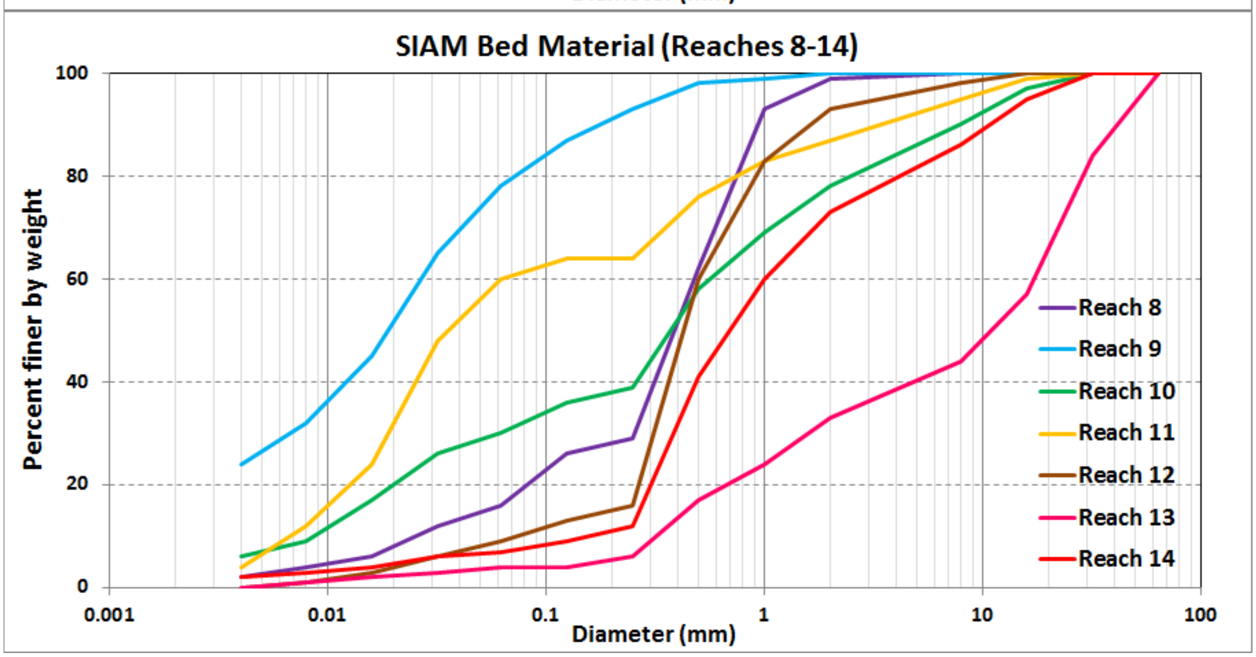


Figure 4.3: Bed Material Gradation for Bound Brook SIAM Sediment Reaches

4.2.4. Sediment Sources

External sediment sources to Bound Brook were based on results of the sediment yield from the watershed SWAT model. SIAM requires sediment supply data to be input for each reach. The sediment supply data are entered by source as annual sediment loads in tons per year per grain class. Two primary sediment sources were identified: channel banks erosion, and upstream or tributary inflows.

Based on field reconnaissance, it was determined that the contribution of bank sediments to the channels due to channel migration occur too slowly to be worth considering as a sediment supply source in the SIAM modeling. Therefore, no estimates of the bank erosion contributions were included in SIAM.

The primary sediment supply for Bound Brook was the contribution from its watershed. During precipitation events, sediments are eroded and subsequently transported to the brook. Based on the results from the watershed sediment yield from the SWAT model (see Section 2), the annual sediment supply to the various reaches are given in Table 4.3. It was assumed that the watershed sediment supply was median silt in texture.

Table 4.3: SIAM Input for Watershed Local Sediment Source

Sediment Reach	River Mile		Local Supply (tons/yr)
	Upstream Extent	Downstream Extent	
1	6.87	6.64	630[1]
2	6.64	6.57	2.1
3[*]	6.57	6.23[3]	9.8
4a	6.23	6.17	2.1
4b[**]	6.17	6.00[2]	5.8
4c	6.00	5.77	7.8
5	5.77	5.39	10
6	5.39	5.04	3.1
7	5.04	4.78	3.1
8	4.78	4.10	28
9[***]	4.10	3.42[1]	32
10	3.42	2.56	12
11	2.56	2.39	2.3
12	2.39	2.18	3.0
13	2.18	1.87	7.8
14	1.87	0.00	44

[1] Upstream Boundary Load
[*] Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
[**] Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
[***] New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

4.2.5. Hydraulics

Hydraulic parameters used in SIAM model calculations were automatically populated from the results of the HEC-RAS simulation. Each discharge specified in the annualized discharge duration profile (see section 4.2.1) corresponds to a flow profile modeled in HEC-RAS. Mean hydraulic values for each profile were determined for each SIAM sediment Reach through a Reach length weighted averaging scheme within HEC-RAS. SIAM uses the reach average values in the sediment transport capacity computations.

4.3. SIAM Results

SIAM is a sediment budget tool that compares annualized sediment transport capacities (i.e., overall sediment surplus or deficit) for each river mile segment, called a "reach." When SIAM simulation is performed, the results of the analysis are presented in different tables and plots with various levels of details. In this study, the model output of interest is a table of sediment supply and balance for each SIAM sediment reach with the following components:

- Local Supply – This represents the source data from SWAT watershed yield that are summarized in Table 4.3 above.
- Transport Capacity – This is the amount of sediment that can be expected to be moved through the reach. It is calculated by determining the hydraulic energy available to transport sediment using the flow-duration curve defined in the input to SIAM (see Table 4.2 above). The hydraulic energy is applied to each available sediment fraction in the bed to determine how much sediment would be available to be transported as a function of grain size. This is called the transport potential of each grain size fraction. The overall transport capacity for the reach is estimated by weighting the transport potential of each grain size as a percentage of what is available in the bed.
- Bed Supply – This is the amount if sediment that can potentially be transported from the next most upstream reach into the current sediment reach. This value is dominated by the transport capacity value from the next upstream reach.
- Wash Supply – This is the sediment loading that is routed through the network as wash load.
- Sum of Local Supplies – This is the sum of local supplies from all upstream reaches.
- The Local Balance is the difference between the transport capacity and the sum of the supplies.

It is worth noting that because SIAM is not a sediment routing model its results represent general trends of surplus and deficit only and not actual volumes of eroded or deposited material. Although SIAM is a very useful sediment management tool, Little and Jonas (2010) indicate that the following limitations should be considered when reviewing the results:

- SIAM does not update the sediment bed based on erosion or deposition (i.e., hydraulics are not updated or changed over time during a model run), and the model does not account for changing capacities in response to potential erosion or deposition.
- No time frame for sediment impacts is computed.

- Reach-averaged values are used in all computations, and therefore, localized effects of hydraulic structures including dams, weirs, and culverts can be overwhelmed by the sediment transport potential estimated for transport capacity.
- There is no supply limitation from the bed in each reach because SIAM assumes erosion will continue indefinitely from the bed until the sediment transport capacity is satisfied. In systems where the local supply from the watershed is limited like in Bound Brook, the sediment transport simulated can be overwhelmed by the transport capacity.

Despite these limitations, SIAM can be used as a screening tool for sediment budget assessment to guide managers in determining areas of potential stability and instability. When scenarios are evaluated, the relative trends estimated by SIAM can help to identify potential restoration priorities and can be the start point for more detailed analysis on the selected restoration option.

4.3.1. Scenario 1: Base Case (Existing Condition)

In this study, the baseline model represents the existing conditions in Bound Brook that were set in SIAM, using inputs from SWAT and HEC-RAS results presented in previous sections of this report. A summary of the reach supply and balance for this scenario is provided in Table 4-4. The model results indicate that there is a deficit (or degradation) in the most upstream SIAM sediment reach (Reach 1). This sediment instability is expected because of boundary condition effects, particularly the relatively small input of sediment from the local watershed in comparison to the transport potential of the reach. The model results indicate that the SIAM sediment reach containing the New Market Pond (Reach 9) has sediment surplus (or aggradation) because of relatively larger potential supply from upstream. Downstream from the New Market Pond, the next three reaches were simulated to have deficit or degradation. It should be noted that the negative local balances in Reaches 6 and 7 are questionable because observed field work in this stretch of the brook suggests that the sediment beds are aggrading and consists of relatively thick beds of fine-grained sediment deposits.

4.3.2. Scenario 2: New Dam Constructed at RM6.2

In this scenario, a dam was placed at RM6.2; it was assumed that the modeled dam had dimensions that were similar in size to the existing New Market Pond dam. The geometry file in HEC-RAS was modified to include this structure. Table 4.5 presents a summary of the SIAM results for this scenario. Implementation of the scenario would result in significant changes upstream of RM6.2 and the modeled dam. Due to the lack of flow upstream of the dam, the energy in the system upstream of the dam is reduced relative to baseline conditions. The transport capacity computed under this scenario for the reaches upstream of the dam (reaches 1 to 4a) are orders of magnitude lower than corresponding values under baseline conditions. Reach 4a which was degrading under baseline conditions, is now simulated to be aggrading under Scenario 2. Model results from reach 4c downstream would not show any changes relative to the baseline scenario.

While the presence of the modeled dam forecasts potential sediment aggradation, it is important to note that there may be flooding implications depending on the dam height. The current simulation assumed a dam height of about 10 feet. If the dam height is increased to 20 feet or more, significant flooding would occur based on results of water elevation from HEC-RAS.

4.3.3. Scenario 3: Removal of Twin Culvert at RM6.55

In this scenario, Bound Brook was modeled assuming that the three existing elliptical reinforced concrete culverts at RM6.55 in SIAM Sediment Reach 3, which is adjacent to the CDE site, were removed from the Brook. Two of these culverts are twin culverts and each having dimensions of approximately 7.5 feet high and 7.0 feet in width. The third culvert, which is separated from the twin culverts (see Figure 4.4) is approximately 5.8 feet high and spans 5.5 feet. The geometry file in HEC-RAS was modified to exclude the structures. Table 4.6 presents a summary of the reach supply and balance for this scenario.

Figure 4.4: Existing Culverts at River Mile 6.55

The SIAM results of this scenario show slightly more sediment aggradation relative to baseline conditions, in the sediment reach upstream of the project upper limit (Reach 1), since the removal of the twin culverts might slightly increase the velocity and energy in that area. The reaches containing the twin culverts show increased aggradation relative to baseline conditions. No changes were simulated for Scenario 3 relative to baseline conditions downstream of Reach 5.

4.3.4. Scenario 4: Removal of Manmade Dam at RM6.0

In this scenario, Bound Brook was modeled assuming that the existing manmade dam at the end of SIAM sediment reach 4b (RM6.0) was removed. Table 4.7 presents a summary of the reach supply and balance for this scenario. The model results show that removal of the dam creates additional sediment deficit in the reach just upstream relative to baseline conditions. This deficit from the reach just upstream results in the supply of sediments to reach 4b creating a surplus after the dam is removed.

Table 4-4. SIAM Reach Supply and Balance for the Baseline Model (Existing Condition)

SIAM Sediment Reach	River Mile		Local Supply (tons/yr)	Transport Capacity (tons/yr)	Bed Supply (tons/yr)	Wash Supply (tons/yr)	Sum Local Supplies (tons/yr)	Local Balance (tons/yr)
	From	To						
Reach 1	6.87	6.64	628	4.55E+06	597	31.4	628	-4.55E+06
Reach 2	6.64	6.57	2.08	2.48E+05	4.55E+06	31.5	630	4.30E+06
Reach 3*	6.57	6.23	9.81	3.99E+06	2.48E+05	32	640	-3.74E+06
Reach 4a	6.23	6.17	2.04	4.26E+06	3.99E+06	32.1	642	-2.69E+05
Reach 4b**	6.17	6.00	5.79	5.49E+07	4.26E+06	32.4	648	-5.07E+07
Reach 4c	6.00	5.77	7.83	1.02E+05	5.49E+07	32.7	655	5.48E+07
Reach 5	5.77	5.39	10.4	3.04E+04	1.02E+05	33.3	666	7.20E+04
Reach 6	5.39	5.04	3.09	2.56E+06	3.04E+04	33.4	669	-2.53E+06
Reach 7	5.04	4.78	3.07	5.86E+06	2.56E+06	33.6	672	-3.31E+06
Reach 8	4.78	4.10	27.7	2.82E+05	5.86E+06	35	700	5.58E+06
Reach 9***	4.10	3.42	32.4	5.79E+04	2.82E+05	36.6	732	2.24E+05
Reach 10	3.42	2.56	12	4.03E+06	5.79E+04	37.2	744	-3.97E+06
Reach 11	2.56	2.39	2.25	5.43E+07	4.03E+06	37.3	746	-5.03E+07
Reach 12	2.39	2.18	2.99	1.89E+08	5.43E+07	37.4	749	-1.35E+08
Reach 13	2.18	1.87	7.84	5.14E+07	1.89E+08	37.8	757	1.38E+08
Reach 14	1.87	0.00	43.8	3.81E+06	5.14E+07	40	801	4.76E+07

* Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
** Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
*** New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

Note: The negative local balances in Reaches 6 and 7 are questionable because observed field work in this stretch of the brook suggests that the sediment beds are aggrading and consists of relatively thick beds of fine-grained sediment deposits.

Table 4-5. SIAM Reach Supply and Balance for the Scenario 2 - New Dam Constructed at RM6.2

SIAM Sediment Reach	River Mile		Local Supply (tons/yr)	Transport Capacity (tons/yr)	Bed Supply (tons/yr)	Wash Supply (tons/yr)	Sum Local Supplies (tons/yr)	Local Balance (tons/yr)
	From	To						
Reach 1	6.87	6.64	628	6328	597	31.4	628	-5.73E+03
Reach 2	6.64	6.57	2.08	13.6	6330	31.5	630	6.32E+03
Reach 3*	6.57	6.23	9.81	9047	22.9	32	640	-9.02E+03
Reach 4a	6.23	6.17	2.04	4507	9049	32.1	642	4.54E+03
Reach 4b**	6.17	6.00	5.79	5.49E+07	4512	32.4	648	-5.49E+07
Reach 4c	6.00	5.77	7.83	1.02E+05	5.49E+07	32.7	655	5.48E+07
Reach 5	5.77	5.39	10.4	3.04E+04	1.02E+05	33.3	666	7.20E+04
Reach 6	5.39	5.04	3.09	2.56E+06	3.04E+04	33.4	669	-2.53E+06
Reach 7	5.04	4.78	3.07	5.86E+06	2.56E+06	33.6	672	-3.31E+06
Reach 8	4.78	4.10	27.7	2.82E+05	5.86E+06	35	700	5.58E+06
Reach 9***	4.10	3.42	32.4	5.79E+04	2.82E+05	36.6	732	2.24E+05
Reach 10	3.42	2.56	12	4.03E+06	5.79E+04	37.2	744	-3.97E+06
Reach 11	2.56	2.39	2.25	5.43E+07	4.03E+06	37.3	746	-5.03E+07
Reach 12	2.39	2.18	2.99	1.89E+08	5.43E+07	37.4	749	-1.35E+08
Reach 13	2.18	1.87	7.84	5.14E+07	1.89E+08	37.8	757	1.38E+08
Reach 14	1.87	0.00	43.8	3.81E+06	5.14E+07	40	801	4.76E+07

* Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
** Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
*** New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

Note: The negative local balances in Reaches 6 and 7 are questionable because observed field work in this stretch of the brook suggests that the sediment beds are aggrading and consists of relatively thick beds of fine-grained sediment deposits.

Table 4-6. SIAM Reach Supply and Balance for the Scenario 3 - Removal of Twin Culverts at RM6.55

SIAM Sediment Reach	River Mile		Local Supply (tons/yr)	Transport Capacity (tons/yr)	Bed Supply (tons/yr)	Wash Supply (tons/yr)	Sum Local Supplies (tons/yr)	Local Balance (tons/yr)
	From	To						
Reach 1	6.87	6.64	628	4.78E+06	597	31.4	628	-4.78E+06
Reach 2	6.64	6.57	2.08	3.03E+05	4.78E+06	31.5	630	4.48E+06
Reach 3*	6.57	6.23	9.81	3.67E+06	3.03E+05	32	640	-3.37E+06
Reach 4a	6.23	6.17	2.04	4.25E+06	3.67E+06	32.1	642	-5.80E+05
Reach 4b**	6.17	6.00	5.79	5.49E+07	4.25E+06	32.4	648	-5.07E+07
Reach 4c	6.00	5.77	7.83	1.02E+05	5.49E+07	32.7	655	5.48E+07
Reach 5	5.77	5.39	10.4	3.04E+04	1.02E+05	33.3	666	7.20E+04
Reach 6	5.39	5.04	3.09	2.56E+06	3.04E+04	33.4	669	-2.53E+06
Reach 7	5.04	4.78	3.07	5.86E+06	2.56E+06	33.6	672	-3.31E+06
Reach 8	4.78	4.10	27.7	2.82E+05	5.86E+06	35	700	5.58E+06
Reach 9***	4.10	3.42	32.4	5.79E+04	2.82E+05	36.6	732	2.24E+05
Reach 10	3.42	2.56	12	4.03E+06	5.79E+04	37.2	744	-3.97E+06
Reach 11	2.56	2.39	2.25	5.43E+07	4.03E+06	37.3	746	-5.03E+07
Reach 12	2.39	2.18	2.99	1.89E+08	5.43E+07	37.4	749	-1.35E+08
Reach 13	2.18	1.87	7.84	5.14E+07	1.89E+08	37.8	757	1.38E+08
Reach 14	1.87	0.00	43.8	3.81E+06	5.14E+07	40	801	4.76E+07

* Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
** Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
*** New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

Note: The negative local balances in Reaches 6 and 7 are questionable because observed field work in this stretch of the brook suggests that the sediment beds are aggrading and consists of relatively thick beds of fine-grained sediment deposits.

Table 4-7. SIAM Reach Supply and Balance for the Scenario 4 - Removal of Manmade Dam at RM6.00

SIAM Sediment Reach	River Mile		Local Supply (tons/yr)	Transport Capacity (tons/yr)	Bed Supply (tons/yr)	Wash Supply (tons/yr)	Sum Local Supplies (tons/yr)	Local Balance (tons/yr)
	From	To						
Reach 1	6.87	6.64	628	4.55E+06	597	31.4	628	-4.55E+06
Reach 2	6.64	6.57	2.08	2.48E+05	4.55E+06	31.5	630	4.30E+06
Reach 3*	6.57	6.23	9.81	3.99E+06	2.48E+05	32	640	-3.74E+06
Reach 4a	6.23	6.17	2.04	6.65E+06	3.99E+06	32.1	642	-2.66E+06
Reach 4b**	6.17	6.00	5.79	2.57E+06	6.65E+06	32.4	648	4.08E+06
Reach 4c	6.00	5.77	7.83	1.02E+05	2.57E+06	32.7	655	2.47E+06
Reach 5	5.77	5.39	10.4	3.04E+04	1.02E+05	33.3	666	7.20E+04
Reach 6	5.39	5.04	3.09	2.56E+06	3.04E+04	33.4	669	-2.53E+06
Reach 7	5.04	4.78	3.07	5.86E+06	2.56E+06	33.6	672	-3.31E+06
Reach 8	4.78	4.10	27.7	2.82E+05	5.86E+06	35	700	5.58E+06
Reach 9***	4.10	3.42	32.4	5.79E+04	2.82E+05	36.6	732	2.24E+05
Reach 10	3.42	2.56	12	4.03E+06	5.79E+04	37.2	744	-3.97E+06
Reach 11	2.56	2.39	2.25	5.43E+07	4.03E+06	37.3	746	-5.03E+07
Reach 12	2.39	2.18	2.99	1.89E+08	5.43E+07	37.4	749	-1.35E+08
Reach 13	2.18	1.87	7.84	5.14E+07	1.89E+08	37.8	757	1.38E+08
Reach 14	1.87	0.00	43.8	3.81E+06	5.14E+07	40	801	4.76E+07

* Twin culverts are located at approximately RM 6.55 in SIAM Sediment Reach 3
** Manmade dam is located at approximately RM 6.00, which is in SIAM Sediment Reach 4b
*** New Market Pond dam is located at approximately RM3.42, which is in SIAM Sediment Reach 9

Note: The negative local balances in Reaches 6 and 7 are questionable because observed field work in this stretch of the brook suggests that the sediment beds are aggrading and consists of relatively thick beds of fine-grained sediment deposits.

5. Summary

A combination of field measurements, watershed hydrologic modeling, hydraulics and sediment transport modeling was used to develop a reach by reach sediment impact analysis for Bound Brook. This analysis is one of the tools used to evaluate potential remediation scenarios for the Bound Brook feasibility study.

The watershed hydrologic and stream hydraulics models were required to provide the necessary inputs for the sediment transport model. The watershed model SWAT was used to simulate stream flows and sediment yields in Bound Brook. Stream flow data available at the USGS stream gauge at Middlesex, New Jersey (Gauge ID: 01403900) were used for calibration and validation of the model simulated flows. In addition, a sediment load rating curve was developed using measured suspended solids concentrations at this gauge. The sediment yield derived from this rating curve was compared to the simulated sediment yield generated by SWAT. Overall, the watershed model was successfully calibrated and validated using the measured flows. The simulated sediment yield also agreed to the sediment yields that were derived from suspended solids concentrations and flow measurements. The sub-watershed delivery of flow and solids were used as input to HEC-RAS and SIAM models.

For in-stream hydraulics modeling, the one-dimensional model HEC-RAS was used to represent the brook. This model provided a reliable method for calculating hydraulic conditions, including water surface elevation, flow depth, and velocity over a range of flows provided by the SWAT model. Channel stream geometry was based on a combination of elevation surveys and USGS National Elevation Dataset digital elevation models. Significant structures like bridges, dams and culverts were fully represented in the model's geometry. Roughness was used as the calibrating parameter, but this parameter was varied within ranges that are based on field observations of debris in stream, vegetation, channel irregularities, degree of meander, obstructions, size and shape of the channel. A comparison of simulated water surface elevations at several points along the brook indicated good agreement to actual elevations measured during the field program.

The sediment assessment model (constructed using SIAM feature in HEC-RAS) was used to evaluate potential changes in sedimentation patterns that could occur due to remedial alternatives assessed as part of the feasibility study. Although SIAM is not a sediment transport model, it was used to compare the annual sediment transport capacity of a stream "reach" (or river mile segment) to the sediment supply, and the model provides an indication of whether sediment aggradation, degradation, or equilibrium may occur.

Under existing conditions, the model produced reliable results with aggradation in the "reach" above New Market Pond dam and degradation below the dam, which is consistent with field observations. For the remedial scenarios evaluated by the model, construction of a new dam at RM6.2 was simulated to produce back-up of water in the reaches above this point. The model suggests that sediment aggradation would occur due to the construction of the new dam. SIAM shows slight changes in supply and deficit of sediments as a result of removing either the twin culverts at RM6.55, and manmade dam at RM6.0. It is recommended that future sensitivity analyses be conducted to understand the uncertainties in the SIAM model results and the significance of some of the parameters used in SIAM (such as wash load, sediment bed gradation, and the specification of sediment reaches).

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Appendix B:
Tabulated Data

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		GB-SHEP-A	GB-SHEP-B	GB-BEECH-A	GB-BEECH-B	GB-GREEN-A	GB-GREEN-C	GB-GREEN-B
Compound	**Units**	**0-15 cm**	**0-15 cm**	**0-20 cm**	**0-15 cm**	**0-28 cm**	**0-15 cm**	**0-20 cm**
Aroclor-1016	ug/kg	18 U	19 U	18 U	21 U	19 U	17 U	20 U
Aroclor-1221	ug/kg	28 U	30 U	27 U	32 U	29 U	26 U	30 U
Aroclor-1232	ug/kg	19 U	21 U	19 U	22 U	20 U	18 U	21 U
Aroclor-1242	ug/kg	18 U	19 U	18 U	21 U	19 U	17 U	20 U
Aroclor-1248	ug/kg	10 U	11 U	10 U	12 U	11 U	9.8 U	11 U
Aroclor-1254	ug/kg	10 U	89	9.9 U	16 J	78	9.5 U	11 U
Aroclor-1260	ug/kg	5.5 U	5.8 U	5.4 U	6.2 U	5.8 U	5.1 U	5.9 U
Aroclor-1262	ug/kg	13 U	14 U	13 U	15 U	14 U	13 U	14 U
Aroclor-1268	ug/kg	6.4 U	6.9 U	6.3 U	7.3 U	6.8 U	6 U	7 U
		15-42 cm	**15-52 cm**	**20-52 cm**	**15-51 cm**	**28-58 cm**	**15-40 cm**	**28-58 cm**
Aroclor-1016	ug/kg	18 U	19 U	18 U	18 U	19 U	17 U	17 U
Aroclor-1221	ug/kg	28 U	29 U	28 U	27 U	29 U	26 U	27 U
Aroclor-1232	ug/kg	19 U	20 U	19 U	19 U	20 U	18 U	19 U
Aroclor-1242	ug/kg	18 U	19 U	18 U	18 U	19 U	17 U	17 U
Aroclor-1248	ug/kg	10 U	11 U	10 U	10 U	11 U	9.7 U	10 U
Aroclor-1254	ug/kg	10 U	53	10 U	9.8 U	10 U	9.4 U	9.6 U
Aroclor-1260	ug/kg	5.5 U	5.7 U	5.5 U	5.3 U	5.7 U	5.1 U	5.2 U
Aroclor-1262	ug/kg	13 U	14 U	13 U	13 U	14 U	12 U	13 U
Aroclor-1268	ug/kg	6.4 U	6.7 U	6.4 U	6.3 U	6.7 U	6 U	6.1 U
			52-75 cm			**58-85 cm**	**40-57 cm**	**58-80 cm**
Aroclor-1016	ug/kg		23 UE			18 U	19 U	17 U
Aroclor-1221	ug/kg		36 UE			28 U	28 U	26 U
Aroclor-1232	ug/kg		25 UE			19 U	20 U	18 U
Aroclor-1242	ug/kg		23 UE			18 U	19 U	17 U
Aroclor-1248	ug/kg		13 UE			10 U	11 U	9.9 U
Aroclor-1254	ug/kg		56 J			10 U	10 U	9.5 U
Aroclor-1260	ug/kg		7 UE			5.4 U	5.6 U	5.2 U
Aroclor-1262	ug/kg		17 UE			13 U	14 U	13 U
Aroclor-1268	ug/kg		8.3 UE			6.4 U	6.5 U	6.1 U
			75-100 cm			**85-115 cm**	**57-70 cm**	**80-93 cm**
Aroclor-1016	ug/kg		18 U			21 U	17 U	18 U
Aroclor-1221	ug/kg		28 U			32 U	26 U	28 U
Aroclor-1232	ug/kg		20 U			23 U	18 U	19 U
Aroclor-1242	ug/kg		18 U			21 U	17 U	18 U
Aroclor-1248	ug/kg		11 U			12 U	9.8 U	10 U
Aroclor-1254	ug/kg		63			12 U	9.4 U	9.9 U
Aroclor-1260	ug/kg		5.5 U			6.4 U	5.1 U	5.4 U
Aroclor-1262	ug/kg		13 U			16 U	13 U	13 U
Aroclor-1268	ug/kg		6.5 U			7.5 U	6 U	6.3 U
			100-135 cm			**115-133 cm**		
Aroclor-1016	ug/kg		22 U			19 U		
Aroclor-1221	ug/kg		34 U			29 U		
Aroclor-1232	ug/kg		23 U			20 U		
Aroclor-1242	ug/kg		22 U			19 U		
Aroclor-1248	ug/kg		13 U			11 U		
Aroclor-1254	ug/kg		160			11 U		
Aroclor-1260	ug/kg		6.6 U			5.7 U		
Aroclor-1262	ug/kg		16 U			14 U		
Aroclor-1268	ug/kg		7.7 U			6.7 U		

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T003A	BB-T003B	BB-T029A	BB-T029B	BB-T055A	BB-T055B	BB-T075A
Compound	**Units**	**0-17 cm**	**0-17 cm**	**0-22 cm**	**0-23 cm**	**0-15 cm**	**0-23 cm**	**0-15 cm**
Aroclor-1016	ug/kg	6.2 U	6.2 U	8 U	6.4 U	6.2 U	6.2 U	7.9 U
Aroclor-1221	ug/kg	7.1 U	7 U	9.1 U	7.2 U	7 U	7 U	8.9 U
Aroclor-1232	ug/kg	10 U	10 U	13 U	10 U	10 U	10 U	13 U
Aroclor-1242	ug/kg	6.4 U	6.3 U	8.2 U	6.5 U	6.3 U	6.3 U	8 U
Aroclor-1248	ug/kg	6.5 U	6.5 U	8.3 U	6.6 U	6.4 U	6.4 U	8.2 U
Aroclor-1254	ug/kg	230	86 J	180 NJ	54 J	50	41 NJ	320 J
Aroclor-1260	ug/kg	7.5 U	7.5 U	9.7 U	7.7 U	7.4 U	7.5 U	9.5 U
Aroclor-1262	ug/kg	20 U	20 U	26 U	20 U	20 U	20 U	25 U
Aroclor-1268	ug/kg	16 U	16 U	21 U	17 U	16 U	16 U	21 U
			17-48 cm	**22-54 cm**		**15-49 cm**	**23-49 cm**	**15-45 cm**
Aroclor-1016	ug/kg		6.1 U	6.1 U		6 U	6.6 U	6.7 U
Aroclor-1221	ug/kg		6.9 U	6.9 U		6.8 U	7.5 U	7.6 U
Aroclor-1232	ug/kg		10 U	10 U		10 U	11 U	11 U
Aroclor-1242	ug/kg		6.2 U	6.2 U		6.2 U	6.7 U	6.9 U
Aroclor-1248	ug/kg		6.4 U	6.4 U		6.3 U	6.9 U	7 U
Aroclor-1254	ug/kg		78 J	6.6 J		76	13 U	220 J
Aroclor-1260	ug/kg		7.4 U	7.4 U		7.3 U	8 U	8.1 U
Aroclor-1262	ug/kg		20 U	20 U		19 U	21 U	22 U
Aroclor-1268	ug/kg		16 U	16 U		16 U	17 U	18 U
						49-74 cm		**45-80 cm**
Aroclor-1016	ug/kg					6.4 U		6.6 U
Aroclor-1221	ug/kg					7.2 U		7.4 U
Aroclor-1232	ug/kg					11 U		11 U
Aroclor-1242	ug/kg					6.5 U		6.7 U
Aroclor-1248	ug/kg					6.7 U		6.8 U
Aroclor-1254	ug/kg					12 U		13 U
Aroclor-1260	ug/kg					7.7 U		7.9 U
Aroclor-1262	ug/kg					21 U		21 U
Aroclor-1268	ug/kg					17 U		17 U

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T075B	BB-T115A	BB-T115B	BB-RM2.48B	BB-T136A	BB-T136B	BB-T156A
Compound	**Units**	**0-15 cm**	**0-13 cm**	**0-12 cm**	**0-30 cm**	**0-15 cm**	**0-15 cm**	**0-15 cm**
Aroclor-1016	ug/kg	5.8 U	6.2 U	6.5 U	30 U	6.5 U	6.8 U	6.2 U
Aroclor-1221	ug/kg	6.6 U	7 U	7.4 U	47 U	7.3 U	7.7 U	7 U
Aroclor-1232	ug/kg	9.6 U	10 U	11 U	32 U	11 U	11 U	10 U
Aroclor-1242	ug/kg	5.9 U	6.3 U	6.6 U	30 U	6.6 U	6.9 U	6.3 U
Aroclor-1248	ug/kg	6.1 U	6.5 U	6.8 U	2200 E	6.7 U	7.1 U	6.4 U
Aroclor-1254	ug/kg	130 J	970 J	960 E	3400 E	140	470	160 J
Aroclor-1260	ug/kg	7 U	140	7.9 U	430 JN	7.8 U	8.2 U	7.5 U
Aroclor-1262	ug/kg	19 U	20 U	21 U	22 U	21 U	22 U	20 U
Aroclor-1268	ug/kg	15 U	16 U	17 U	11 U	17 U	18 U	16 U
		15-45 cm	**13-40 cm**	**12-39 cm**	**30-56 cm**	**15-33 cm**	**15-48 cm**	**15-32 cm**
Aroclor-1016	ug/kg	6 U	6.3 U	9.6 U	23 U	8.3 U	6.5 U	6.2 U
Aroclor-1221	ug/kg	6.8 U	7.1 U	11 U	35 U	9.3 U	7.3 U	7.1 U
Aroclor-1232	ug/kg	9.9 U	10 U	16 U	24 U	14 U	11 U	10 U
Aroclor-1242	ug/kg	6.1 U	6.4 U	9.8 U	23 U	8.4 U	6.6 U	6.4 U
Aroclor-1248	ug/kg	6.3 U	6.5 U	10 U	13 U	8.6 U	6.7 U	6.5 U
Aroclor-1254	ug/kg	12 U	47 J	760	51	430	240	12 U
Aroclor-1260	ug/kg	7.3 U	7.6 U	12 U	6.8 U	10 U	7.8 U	7.5 U
Aroclor-1262	ug/kg	19 U	20 U	31 U	17 U	27 U	21 U	20 U
Aroclor-1268	ug/kg	16 U	16 U	25 U	8 U	22 U	17 U	16 U
		45-75 cm	**40-52 cm**	**39-46 cm**		**33-58 cm**		
Aroclor-1016	ug/kg	5.8 U	7.5 U	6.6 U		6.7 U		
Aroclor-1221	ug/kg	6.5 U	8.5 U	7.5 U		7.6 U		
Aroclor-1232	ug/kg	9.5 U	12 U	11 U		11 U		
Aroclor-1242	ug/kg	5.9 U	7.7 U	6.8 U		6.9 U		
Aroclor-1248	ug/kg	6 U	7.8 U	6.9 U		7 U		
Aroclor-1254	ug/kg	11 U	150 J	15 J		240		
Aroclor-1260	ug/kg	7 U	9.1 U	8 U		8.1 U		
Aroclor-1262	ug/kg	19 U	24 U	21 U		22 U		
Aroclor-1268	ug/kg	15 U	20 U	17 U		18 U		
		75-95 cm						
Aroclor-1016	ug/kg	6 U						
Aroclor-1221	ug/kg	6.8 U						
Aroclor-1232	ug/kg	9.9 U						
Aroclor-1242	ug/kg	6.1 U						
Aroclor-1248	ug/kg	6.3 U						
Aroclor-1254	ug/kg	12 U						
Aroclor-1260	ug/kg	7.3 U						
Aroclor-1262	ug/kg	19 U						
Aroclor-1268	ug/kg	16 U						

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T156B	BB-RM3.03A	BB-T180A	BB-T180B	NMP-T002A	NMP-T003C	NMP-T004B
Compound	**Units**	**0-15 cm**	**0-30 cm**	**0-15 cm**	**0-15 cm**	**0-20 cm**	**0-15 cm**	**0-8 cm**
Aroclor-1016	ug/kg	6.7 U	33 U	6.5 U	6.5 UE	20 UE	19 UE	9.4 U
Aroclor-1221	ug/kg	7.6 U	51 U	7.3 U	7.3 UE	23 UE	21 UE	11 U
Aroclor-1232	ug/kg	11 U	35 U	11 U	11 UE	33 UE	31 UE	16 U
Aroclor-1242	ug/kg	6.9 U	33 U	6.6 U	6.6 UE	21 UE	19 UE	9.6 U
Aroclor-1248	ug/kg	7 U	19 U	6.7 U	6.8 UE	21 UE	19 UE	9.8 U
Aroclor-1254	ug/kg	560	11000 E	130 NJ	260 J	4400 J	3100 J	2000 E
Aroclor-1260	ug/kg	8.1 U	9.9 U	7.8 U	7.9 UE	24 UE	23 UE	11 U
Aroclor-1262	ug/kg	22 U	24 U	21 U	21 UE	65 UE	60 UE	30 U
Aroclor-1268	ug/kg	18 U	12 U	17 U	17 UE	53 UE	49 UE	25 U
		15-49 cm	**30-60 cm**	**15-45 cm**	**15-45 cm**	**20-46 cm**	**15-29 cm**	**8-45 cm**
Aroclor-1016	ug/kg	6.6 U	18 U	6.2 U	6.5 UE	15 U	12 U	6.3 U
Aroclor-1221	ug/kg	7.4 U	28 U	7 U	7.3 UE	17 U	14 U	7.1 U
Aroclor-1232	ug/kg	11 U	19 U	10 U	11 UE	25 U	20 U	10 U
Aroclor-1242	ug/kg	6.7 U	18 U	6.3 U	6.6 UE	15 U	12 U	6.4 U
Aroclor-1248	ug/kg	6.8 U	10 U	6.4 U	6.8 UE	16 U	13 U	6.6 U
Aroclor-1254	ug/kg	13 U	10 U	110 J	190 J	3700 E	2400 J	64
Aroclor-1260	ug/kg	7.9 U	5.5 U	7.4 U	7.8 UE	18 U	15 U	7.6 U
Aroclor-1262	ug/kg	21 U	13 U	20 U	21 UE	48 U	39 U	20 U
Aroclor-1268	ug/kg	17 U	6.4 U	16 U	17 UE	39 U	31 U	16 U
				45-70 cm	**45-70 cm**	**46-74 cm**	**29-61 cm**	
Aroclor-1016	ug/kg			6.1 U	6.7 UE	6.2 U	6.1 U	
Aroclor-1221	ug/kg			6.9 U	7.6 UE	7 U	6.9 U	
Aroclor-1232	ug/kg			10 U	11 UE	10 U	10 U	
Aroclor-1242	ug/kg			6.2 U	6.8 UE	6.3 U	6.2 U	
Aroclor-1248	ug/kg			6.4 U	7 UE	6.5 U	6.4 U	
Aroclor-1254	ug/kg			210 NJ	88 J	20 J	4.9 J	
Aroclor-1260	ug/kg			7.4 U	8.1 UE	7.5 U	7.4 U	
Aroclor-1262	ug/kg			20 U	22 UE	20 U	20 U	
Aroclor-1268	ug/kg			16 U	17 UE	16 U	16 U	
				70-93 cm		**74-99 cm**		
Aroclor-1016	ug/kg			6.2 U		6.7 U		
Aroclor-1221	ug/kg			7 U		7.6 U		
Aroclor-1232	ug/kg			10 U		11 U		
Aroclor-1242	ug/kg			6.3 U		6.8 U		
Aroclor-1248	ug/kg			6.5 U		7 U		
Aroclor-1254	ug/kg			500		13 U		
Aroclor-1260	ug/kg			95		8.1 U		
Aroclor-1262	ug/kg			20 U		22 U		
Aroclor-1268	ug/kg			16 U		17 U		
						99-126 cm		
Aroclor-1016	ug/kg					7.2 U		
Aroclor-1221	ug/kg					8.2 U		
Aroclor-1232	ug/kg					12 U		
Aroclor-1242	ug/kg					7.4 U		
Aroclor-1248	ug/kg					7.5 U		
Aroclor-1254	ug/kg					14 U		
Aroclor-1260	ug/kg					8.7 U		
Aroclor-1262	ug/kg					23 U		
Aroclor-1268	ug/kg					19 U		

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		NMP-T007B	NMP-T010C	NMP-T014C	NMP-T017B	NMP-T020C	NMP-T022A	BB-T217A
Compound	**Units**	**0-10 cm**	**0-15 cm**	**0-25 cm**	**0-17 cm**	**0-15 cm**	**0-10 cm**	**0-25 cm**
Aroclor-1016	ug/kg	6.6 U	18 UE	15 U	8.8 U	11 U	6.3 U	14 UE
Aroclor-1221	ug/kg	7.4 U	20 UE	17 U	9.9 U	12 U	7.2 U	16 UE
Aroclor-1232	ug/kg	11 U	29 UE	25 U	14 U	18 U	10 U	23 UE
Aroclor-1242	ug/kg	6.7 U	18 UE	16 U	8.9 U	11 U	6.5 U	14 UE
Aroclor-1248	ug/kg	6.8 U	18 UE	16 U	9.1 U	11 U	6.6 U	14 UE
Aroclor-1254	ug/kg	370	4100 J	4200 E	1400 E	2300 E	270	27 UE
Aroclor-1260	ug/kg	7.9 U	21 UE	19 U	11 U	13 U	7.7 U	17 UE
Aroclor-1262	ug/kg	21 U	57 UE	50 U	28 U	35 U	20 U	44 UE
Aroclor-1268	ug/kg	17 U	46 UE	40 U	23 U	28 U	17 U	36 UE
		10-30 cm	**15-30 cm**	**25-48 cm**	**17-45 cm**	**15-30 cm**	**10-40 cm**	**25-50 cm**
Aroclor-1016	ug/kg	6 U	14 U	14 U	7.6 U	6.5 U	15 U	6.8 UE
Aroclor-1221	ug/kg	6.7 U	16 U	16 U	8.6 U	7.4 U	17 U	7.6 UE
Aroclor-1232	ug/kg	9.8 U	23 U	23 U	13 U	11 U	25 U	11 UE
Aroclor-1242	ug/kg	6.1 U	14 U	14 U	7.8 U	6.6 U	15 U	6.9 UE
Aroclor-1248	ug/kg	6.2 U	14 U	15 U	7.9 U	6.8 U	16 U	7 UE
Aroclor-1254	ug/kg	14 J	3800 J	4400 E	23 J	13 U	170	13 UE
Aroclor-1260	ug/kg	7.2 U	17 U	17 U	9.2 U	7.9 U	18 U	8.1 UE
Aroclor-1262	ug/kg	19 U	45 U	45 U	25 U	21 U	49 U	22 UE
Aroclor-1268	ug/kg	16 U	36 U	37 U	20 U	17 U	39 U	18 UE
			30-40 cm	**48-69 cm**	**45-73 cm**	**30-63 cm**	**40-70 cm**	**50-70 cm**
Aroclor-1016	ug/kg		6.5 U	6.5 U	8.1 U	6.8 U	14 U	6.6 U
Aroclor-1221	ug/kg		7.3 U	7.3 U	9.2 U	7.7 U	16 U	7.4 U
Aroclor-1232	ug/kg		11 U	11 U	13 U	11 U	24 U	11 U
Aroclor-1242	ug/kg		6.6 U	6.6 U	8.3 U	6.9 U	15 U	6.7 U
Aroclor-1248	ug/kg		6.7 U	6.8 U	8.5 U	7.1 U	15 U	6.8 U
Aroclor-1254	ug/kg		290	13 U	23 J	13 U	28 U	13 U
Aroclor-1260	ug/kg		7.8 U	7.8 U	9.8 U	8.2 U	17 U	7.9 U
Aroclor-1262	ug/kg		21 U	21 U	26 U	22 U	46 U	21 U
Aroclor-1268	ug/kg		17 U	17 U	21 U	18 U	38 U	17 U
				69-94 cm			**70-100 cm**	**70-90 cm**
Aroclor-1016	ug/kg			6.6 U			16 U	6.7 U
Aroclor-1221	ug/kg			7.5 U			18 U	7.5 U
Aroclor-1232	ug/kg			11 U			26 U	11 U
Aroclor-1242	ug/kg			6.7 U			16 U	6.8 U
Aroclor-1248	ug/kg			6.9 U			17 U	7 U
Aroclor-1254	ug/kg			13 U			31 U	13 U
Aroclor-1260	ug/kg			8 U			19 U	8.1 U
Aroclor-1262	ug/kg			21 U			51 U	22 U
Aroclor-1268	ug/kg			17 U			41 U	17 U
				94-124 cm			**100-130 cm**	
Aroclor-1016	ug/kg			6 U			16 U	
Aroclor-1221	ug/kg			6.7 U			18 U	
Aroclor-1232	ug/kg			9.9 U			26 U	
Aroclor-1242	ug/kg			6.1 U			16 U	
Aroclor-1248	ug/kg			6.2 U			16 U	
Aroclor-1254	ug/kg			12 U			31 U	
Aroclor-1260	ug/kg			7.2 U			19 U	
Aroclor-1262	ug/kg			19 U			51 U	
Aroclor-1268	ug/kg			16 U			41 U	
							130-153 cm	
Aroclor-1016	ug/kg						8.2 U	
Aroclor-1221	ug/kg						9.2 U	
Aroclor-1232	ug/kg						13 U	
Aroclor-1242	ug/kg						8.3 U	
Aroclor-1248	ug/kg						8.5 U	
Aroclor-1254	ug/kg						16 U	
Aroclor-1260	ug/kg						9.9 U	
Aroclor-1262	ug/kg						26 U	
Aroclor-1268	ug/kg						21 U	

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-T217B	BB-T231A	BB-T231B	BB-T231C	BB-T255A	BB-T255B	BB-T267A
Compound	Units	0-13 cm	0-15 cm	0-15 cm	0-15 cm	0-15 cm	0-15 cm	0-15 cm
Aroclor-1016	ug/kg	9.7 U	8.8 U	16 U	23 UE	8.7 U	8.9 U	13 U
Aroclor-1221	ug/kg	11 U	9.9 U	18 U	26 UE	9.9 U	10 U	15 U
Aroclor-1232	ug/kg	16 U	14 U	27 U	38 UE	14 U	15 U	22 U
Aroclor-1242	ug/kg	9.9 U	8.9 U	17 U	23 UE	8.9 U	9.1 U	14 U
Aroclor-1248	ug/kg	10 U	9.1 U	17 U	24 UE	9.1 U	9.2 U	14 U
Aroclor-1254	ug/kg	1700 E	3800 PE	380	15000 J	2800 E	6900 PE	4300 PE
Aroclor-1260	ug/kg	160	290 NJ	20 U	1200 JN	11 U	390 J	390
Aroclor-1262	ug/kg	31 U	28 U	53 U	74 UE	28 U	29 U	43 U
Aroclor-1268	ug/kg	25 U	23 U	43 U	60 UE	23 U	23 U	35 U
		13-36 cm	15-48 cm	15-40 cm	15-46 cm	15-45 cm	15-26 cm	15-37 cm
Aroclor-1016	ug/kg	7.1 U	63 U	19 UE	20 UE	48 U	6.6 U	13 U
Aroclor-1221	ug/kg	8 U	71 U	22 UE	23 UE	54 U	7.4 U	15 U
Aroclor-1232	ug/kg	12 U	100 U	32 UE	33 UE	79 U	11 U	21 U
Aroclor-1242	ug/kg	7.2 U	64 U	20 UE	21 UE	49 U	6.7 U	13 U
Aroclor-1248	ug/kg	7.4 U	65 U	20 UE	21 UE	50 U	6.9 U	13 U
Aroclor-1254	ug/kg	930 E	37000 CE	38 UE	140 J	30000 CE	2500 E	6300 PE
Aroclor-1260	ug/kg	80	2300 J	23 UE	24 UE	58 U	150	540
Aroclor-1262	ug/kg	23 U	200 U	62 UE	65 UE	150 U	21 U	41 U
Aroclor-1268	ug/kg	19 U	160 U	50 UE	53 UE	120 U	17 U	34 U
		36-70 cm	48-78 cm	40-70 cm	46-76 cm	45-66 cm		37-46 cm
Aroclor-1016	ug/kg	6.3 U	6.8 U	8.9 U	8.2 U	13 U		6.6 U
Aroclor-1221	ug/kg	7.1 U	7.6 U	10 U	9.2 U	14 U		7.5 U
Aroclor-1232	ug/kg	10 U	11 U	15 U	13 U	21 U		11 U
Aroclor-1242	ug/kg	6.4 U	6.9 U	9 U	8.3 U	13 U		6.7 U
Aroclor-1248	ug/kg	6.5 U	7 U	9.2 U	8.5 U	13 U		6.9 U
Aroclor-1254	ug/kg	190 J	61	17 U	16 U	9100 E		150
Aroclor-1260	ug/kg	7.6 U	8.2 U	11 U	9.9 U	15 U		24 J
Aroclor-1262	ug/kg	20 U	22 U	29 U	26 U	41 U		21 U
Aroclor-1268	ug/kg	16 U	18 U	23 U	21 U	33 U		17 U
		70-100 cm	78-108 cm	70-94 cm	76-107 cm			
Aroclor-1016	ug/kg	6.6 U	6.5 U	5.6 U	9.1 U			
Aroclor-1221	ug/kg	7.4 U	7.4 U	6.3 U	10 U			
Aroclor-1232	ug/kg	11 U	11 U	9.2 U	15 U			
Aroclor-1242	ug/kg	6.7 U	6.7 U	5.7 U	9.3 U			
Aroclor-1248	ug/kg	6.8 U	6.8 U	5.8 U	9.5 U			
Aroclor-1254	ug/kg	13 U	13 U	11 U	18 U			
Aroclor-1260	ug/kg	7.9 U	7.9 U	6.8 U	11 U			
Aroclor-1262	ug/kg	21 U	21 U	18 U	29 U			
Aroclor-1268	ug/kg	17 U	17 U	15 U	24 U			
		100-115 cm	108-138 cm					
Aroclor-1016	ug/kg	7.2 U	7 U					
Aroclor-1221	ug/kg	8.1 U	7.9 U					
Aroclor-1232	ug/kg	12 U	12 U					
Aroclor-1242	ug/kg	7.3 U	7.1 U					
Aroclor-1248	ug/kg	7.4 U	7.3 U					
Aroclor-1254	ug/kg	14 UE	14 U					
Aroclor-1260	ug/kg	8.6 U	8.4 U					
Aroclor-1262	ug/kg	23 U	23 U					
Aroclor-1268	ug/kg	19 U	18 U					
			138-152 cm					
Aroclor-1016	ug/kg		6.5 U					
Aroclor-1221	ug/kg		7.3 U					
Aroclor-1232	ug/kg		11 U					
Aroclor-1242	ug/kg		6.6 U					
Aroclor-1248	ug/kg		6.7 U					
Aroclor-1254	ug/kg		13 U					
Aroclor-1260	ug/kg		7.8 U					
Aroclor-1262	ug/kg		21 U					
Aroclor-1268	ug/kg		17 U					

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T267B	BB-T282A	BB-T282B	TRB-NEWBRUN	TRB-ELSIE	BB-T304A	BB-T304B
Compound	**Units**	**0-15 cm**	**0-15 cm**	**0-16 cm**	**0-15 cm**	**0-15 cm**	**0-15 cm**	**0-13 cm**
Aroclor-1016	ug/kg	6.3 U	7.1 U	6.5 U	6.9 U	6.2 U	8 U	7.4 U
Aroclor-1221	ug/kg	7.2 U	8 U	7.4 U	7.8 U	7 U	9.1 U	8.3 U
Aroclor-1232	ug/kg	10 U	12 U	11 U	11 U	10 U	13 U	12 U
Aroclor-1242	ug/kg	6.5 U	7.3 U	6.7 U	7 U	6.4 U	8.2 U	7.5 U
Aroclor-1248	ug/kg	6.6 U	7.4 U	6.8 U	7.2 U	6.5 U	8.4 U	7.7 U
Aroclor-1254	ug/kg	490	1700 J	1200 E	13 U	12 U	7400 PE	1200 E
Aroclor-1260	ug/kg	54 NJ	200 NJ	7.9 U	8.3 U	7.5 U	520	160
Aroclor-1262	ug/kg	20 U	23 U	21 U	22 U	20 U	26 U	24 U
Aroclor-1268	ug/kg	17 U	19 U	17 U	18 U	16 U	21 U	19 U
			15-29 cm		**15-45 cm**	**15-32 cm**	**15-38 cm**	**13-23 cm**
Aroclor-1016	ug/kg		7.7 U		6.4 U	6.1 U	6.6 U	6.5 U
Aroclor-1221	ug/kg		8.7 U		7.2 U	6.9 U	7.5 U	7.4 U
Aroclor-1232	ug/kg		13 U		11 U	10 U	11 U	11 U
Aroclor-1242	ug/kg		7.9 U		6.5 U	6.2 U	6.8 U	6.7 U
Aroclor-1248	ug/kg		8 U		6.7 U	6.3 U	6.9 U	6.8 U
Aroclor-1254	ug/kg		5300 PE		12 U	120 J	4500 E	19 J
Aroclor-1260	ug/kg		470 NJ		7.7 U	7.3 U	290 J	7.9 U
Aroclor-1262	ug/kg		25 U		21 U	20 U	21 U	21 U
Aroclor-1268	ug/kg		20 U		17 U	16 U	17 U	17 U
					45-58 cm		**38-62 cm**	
Aroclor-1016	ug/kg				6.3 U		6.3 U	
Aroclor-1221	ug/kg				7.1 U		7.1 U	
Aroclor-1232	ug/kg				10 U		10 U	
Aroclor-1242	ug/kg				6.4 U		6.4 U	
Aroclor-1248	ug/kg				6.5 U		6.5 U	
Aroclor-1254	ug/kg				12 U		12 U	
Aroclor-1260	ug/kg				7.6 U		7.6 U	
Aroclor-1262	ug/kg				20 U		20 U	
Aroclor-1268	ug/kg				16 U		16 U	

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-T309A	BB-T309B	TRB-SPRING	BB-T319A	BB-T319B	BB-T323A	BB-T323B
Compound	**Units**	**0-14 cm**	**0-18 cm**	**0-21 cm**	**0-27 cm**	**0-15 cm**	**3-16 cm**	**0-15 cm**
Aroclor-1016	ug/kg	6.7 U	6.3 U	6.1 U	6.2 U	6.2 U	6.1 U	6.2 U
Aroclor-1221	ug/kg	7.6 U	7.1 U	6.9 U	7 U	7 U	6.9 U	7 U
Aroclor-1232	ug/kg	11 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor-1242	ug/kg	6.9 U	6.4 U	6.3 U	6.3 U	6.3 U	6.3 U	6.4 U
Aroclor-1248	ug/kg	7 U	6.6 U	6.4 U	6.4 U	6.5 U	6.4 U	6.5 U
Aroclor-1254	ug/kg	4000 E	2100 E	57 NJ	2200 E	1100 E	2100 J	1600 E
Aroclor-1260	ug/kg	8.1 U	7.6 U	7.4 U	170	92	7.4 U	130
Aroclor-1262	ug/kg	22 U	20 U	20 U	20 U	20 U	20 U	20 U
Aroclor-1268	ug/kg	18 U	16 U	16 U	16 U	16 U	16 U	16 U
		14-36 cm	**18-38 cm**			**15-53 cm**		**15-33 cm**
Aroclor-1016	ug/kg	8.7 U	6.4 U			6.1 U		6 U
Aroclor-1221	ug/kg	9.8 U	7.3 U			6.9 U		6.7 U
Aroclor-1232	ug/kg	14 U	11 U			10 U		9.8 U
Aroclor-1242	ug/kg	8.8 U	6.5 U			6.2 U		6.1 U
Aroclor-1248	ug/kg	9 U	6.7 U			6.3 U		6.2 U
Aroclor-1254	ug/kg	7300 E	1500 E			4300 E		2400 E
Aroclor-1260	ug/kg	10 U	7.8 U			250		240
Aroclor-1262	ug/kg	28 U	21 U			20 U		19 U
Aroclor-1268	ug/kg	23 U	17 U			16 U		16 U
		36-49 cm	**38-54 cm**					
Aroclor-1016	ug/kg	6.6 U	7.1 U					
Aroclor-1221	ug/kg	7.5 U	8 U					
Aroclor-1232	ug/kg	11 U	12 U					
Aroclor-1242	ug/kg	6.7 U	7.2 U					
Aroclor-1248	ug/kg	6.9 U	7.4 U					
Aroclor-1254	ug/kg	2400 E	68					
Aroclor-1260	ug/kg	8 U	8.6 U					
Aroclor-1262	ug/kg	21 U	23 U					
Aroclor-1268	ug/kg	17 U	18 U					

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-T328A	BB-T328B	BB-T333A	BB-T333B	BB-T337A	BB-T337B	BB-T339A
Compound	**Units**	**0-10 cm**	**0-15 cm**	**0-17 cm**	**0-5 cm**	**0-17 cm**	**0-17 cm**	**0-25 cm**
Aroclor-1016	ug/kg	6.5 U	6.1 U	6.6 U	6.4 U	76 U	74 U	32 U
Aroclor-1221	ug/kg	7.4 U	6.9 U	7.4 U	7.3 U	86 U	84 U	37 U
Aroclor-1232	ug/kg	11 U	10 U	11 U	11 U	120 U	120 U	54 U
Aroclor-1242	ug/kg	6.6 U	6.3 U	6.7 U	6.6 U	63000 CE	150000 J	33 U
Aroclor-1248	ug/kg	6.8 U	6.4 U	6.8 U	6.7 U	79 U	77 U	34 U
Aroclor-1254	ug/kg	1000 E	2300 E	1000 E	810 E	61000 PCE	85000 PCE	26000 PCE
Aroclor-1260	ug/kg	7.9 U	7.4 U	84	72	92 U	90 U	39 U
Aroclor-1262	ug/kg	21 U	20 U	21 U	21 U	240 U	240 U	100 U
Aroclor-1268	ug/kg	17 U	16 U	17 U	17 U	200 U	190 U	85 U
			15-40 cm					
Aroclor-1016	ug/kg		6.1 U					
Aroclor-1221	ug/kg		6.9 U					
Aroclor-1232	ug/kg		10 U					
Aroclor-1242	ug/kg		4100 J					
Aroclor-1248	ug/kg		6.3 U					
Aroclor-1254	ug/kg		9000 J					
Aroclor-1260	ug/kg		7.3 U					
Aroclor-1262	ug/kg		20 U					
Aroclor-1268	ug/kg		16 U					

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T339B	BB-T344A	BB-T344B	BB-T346A	BB-T346B	BB-T348A	BB-T348B
Compound	**Units**	**0-16 cm**	**0-23 cm**	**0-13 cm**	**0-16 cm**	**0-12 cm**	**0-15 cm**	**0-20 cm**
Aroclor-1016	ug/kg	27 U	8.8 U	6.7 U	47 U	7.5 U	29 UE	35 U
Aroclor-1221	ug/kg	31 U	10 U	7.5 U	54 U	8.5 U	32 UE	39 U
Aroclor-1232	ug/kg	45 U	15 U	11 U	78 U	12 U	47 UE	57 U
Aroclor-1242	ug/kg	28 U	3500 NJ	1100 J	16000 NJ	7.7 U	7200 NJ	21000 J
Aroclor-1248	ug/kg	29 U	9.2 U	6.9 U	49 U	7.8 U	30 UE	36 U
Aroclor-1254	ug/kg	16000 J	2900 E	2100 J	37000 J	54	25000 J	49000 J
Aroclor-1260	ug/kg	33 U	11 U	8 U	57 U	9.1 U	34 UE	42 U
Aroclor-1262	ug/kg	88 U	28 U	21 U	150 U	24 U	92 UE	110 U
Aroclor-1268	ug/kg	71 U	23 U	17 U	120 U	20 U	74 UE	90 U
							15-33 cm	**20-53 cm**
Aroclor-1016	ug/kg						6.6 UE	6.1 U
Aroclor-1221	ug/kg						7.5 UE	6.9 U
Aroclor-1232	ug/kg						11 UE	10 U
Aroclor-1242	ug/kg						1700 J	3700 ES
Aroclor-1248	ug/kg						6.9 UE	6.3 U
Aroclor-1254	ug/kg						13 UE	12 U
Aroclor-1260	ug/kg						8 UE	7.3 U
Aroclor-1262	ug/kg						21 UE	20 U
Aroclor-1268	ug/kg						17 UE	16 U
								53-83 cm
Aroclor-1016	ug/kg							6.2 U
Aroclor-1221	ug/kg							7 U
Aroclor-1232	ug/kg							10 U
Aroclor-1242	ug/kg							440 S
Aroclor-1248	ug/kg							6.5 U
Aroclor-1254	ug/kg							12 U
Aroclor-1260	ug/kg							7.5 U
Aroclor-1262	ug/kg							20 U
Aroclor-1268	ug/kg							16 U

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-T350A	BB-T350B	BB-T353A	BB-T353B	BB-T363A	BB-T363B	BB-RM7.11A
Compound	**Units**	**0-15 cm**	**0-23 cm**	**0-15 cm**	**0-15 cm**	**0-20 cm**	**0-23 cm**	**0-15 cm**
Aroclor-1016	ug/kg	59 U	7 U	7.7 U	6.4 U	6.7 U	7.2 U	7.1 U
Aroclor-1221	ug/kg	66 U	7.9 U	8.7 U	7.3 U	7.5 U	8.1 U	8 U
Aroclor-1232	ug/kg	97 U	12 U	13 U	11 U	11 U	12 U	12 U
Aroclor-1242	ug/kg	60 U	7.1 U	7.9 U	6.6 U	6.8 U	7.3 U	7.2 U
Aroclor-1248	ug/kg	61 U	7.3 U	8 U	6.7 U	6.9 U	7.5 U	7.4 U
Aroclor-1254	ug/kg	32000 J	780 J	370 J	40 J	170 J	14 U	240 J
Aroclor-1260	ug/kg	71 U	8.4 U	9.3 U	7.8 U	8.1 U	8.7 U	8.6 U
Aroclor-1262	ug/kg	190 U	23 U	25 U	21 U	22 U	23 U	23 U
Aroclor-1268	ug/kg	150 U	18 U	20 U	17 U	17 U	19 U	19 U
		15-32 cm		**15-45 cm**				**15-45 cm**
Aroclor-1016	ug/kg	110 U		7.3 U				7.1 U
Aroclor-1221	ug/kg	120 U		8.3 U				8 U
Aroclor-1232	ug/kg	180 U		12 U				12 U
Aroclor-1242	ug/kg	110 U		7.5 U				7.3 U
Aroclor-1248	ug/kg	110 U		7.6 U				7.4 U
Aroclor-1254	ug/kg	190000 J		320 J				310
Aroclor-1260	ug/kg	130 U		8.9 U				8.6 U
Aroclor-1262	ug/kg	340 U		24 U				23 U
Aroclor-1268	ug/kg	280 U		19 U				19 U
				45-59 cm				**45-79 cm**
Aroclor-1016	ug/kg			6 U				7.6 U
Aroclor-1221	ug/kg			6.8 U				8.5 U
Aroclor-1232	ug/kg			9.9 U				12 U
Aroclor-1242	ug/kg			6.1 U				7.7 U
Aroclor-1248	ug/kg			6.3 U				7.9 U
Aroclor-1254	ug/kg			12 U				440
Aroclor-1260	ug/kg			7.3 U				9.1 U
Aroclor-1262	ug/kg			19 U				24 U
Aroclor-1268	ug/kg			16 U				20 U

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		BB-RM7.11B	BB-RM7.33A	BB-RM7.33B	BB-RM7.41A	BB-RM7.41B	BB-RM7.55A	BB-RM7.55B
Compound	**Units**	**0-15 cm**	**0-15 cm**	**0-15 cm**	**0-25 cm**	**0-13 cm**	**0-25 cm**	**0-20 cm**
Aroclor-1016	ug/kg	6.4 U	7.3 U	6.5 U	18 U	19 U	20 U	25 U
Aroclor-1221	ug/kg	7.3 U	8.3 U	7.4 U	28 U	29 U	30 U	38 U
Aroclor-1232	ug/kg	11 U	12 U	11 U	20 U	20 U	21 U	26 U
Aroclor-1242	ug/kg	6.6 U	7.5 U	6.6 U	18 U	19 U	20 U	25 U
Aroclor-1248	ug/kg	6.7 U	7.6 U	6.8 U	10 U	11 U	11 U	14 U
Aroclor-1254	ug/kg	100	14 U	13 U	10 U	11 U	11 U	14 U
Aroclor-1260	ug/kg	32 J	8.8 U	7.9 U	5.5 U	5.7 U	5.9 U	7.4 U
Aroclor-1262	ug/kg	21 U	24 U	21 U	13 U	14 U	14 U	18 U
Aroclor-1268	ug/kg	17 U	19 U	17 U	6.5 U	6.7 U	6.9 U	8.7 U
		15-47 cm	**15-53 cm**	**15-39 cm**	**25-53 cm**	**13-24 cm**	**25-44 cm**	**20-42 cm**
Aroclor-1016	ug/kg	6.5 U	6.3 U	6.8 U	18 U	18 U	21 U	22 U
Aroclor-1221	ug/kg	7.4 U	7.1 U	7.6 U	28 U	28 U	32 U	34 U
Aroclor-1232	ug/kg	11 U	10 U	11 U	19 U	19 U	23 U	23 U
Aroclor-1242	ug/kg	6.6 U	6.4 U	6.9 U	18 U	18 U	21 U	22 U
Aroclor-1248	ug/kg	6.8 U	6.5 U	7 U	10 U	10 U	12 U	13 U
Aroclor-1254	ug/kg	140	12 U	13 U	10 U	10 U	12 U	12 U
Aroclor-1260	ug/kg	7.9 U	24 J	8.2 U	5.4 U	5.5 U	6.4 U	6.6 U
Aroclor-1262	ug/kg	21 U	20 U	22 U	13 U	13 U	16 U	16 U
Aroclor-1268	ug/kg	17 U	16 U	18 U	6.4 U	6.4 U	7.5 U	7.7 U
		47-65 cm	**53-83 cm**	**39-67 cm**	**53-80 cm**	**24-42 cm**	**44-73 cm**	**42-62 cm**
Aroclor-1016	ug/kg	8.1 U	6.4 U	6.2 U	18 U	18 U	20 U	19 U
Aroclor-1221	ug/kg	9.2 U	7.3 U	7 U	27 U	28 U	31 U	29 U
Aroclor-1232	ug/kg	13 U	11 U	10 U	19 U	19 U	22 U	20 U
Aroclor-1242	ug/kg	8.3 U	6.6 U	6.4 U	18 U	18 U	20 U	19 U
Aroclor-1248	ug/kg	8.5 U	6.7 U	6.5 U	10 U	10 U	12 U	11 U
Aroclor-1254	ug/kg	370	13 U	12 U	9.7 U	10 U	11 U	10 U
Aroclor-1260	ug/kg	59	7.8 U	7.5 U	5.3 U	5.4 U	6.1 U	5.7 U
Aroclor-1262	ug/kg	26 U	21 U	20 U	13 U	13 U	15 U	14 U
Aroclor-1268	ug/kg	21 U	17 U	16 U	6.2 U	6.4 U	7.2 U	6.7 U
			83-126 cm	**67-91 cm**		**42-60 cm**	**73-107 cm**	**62-81 cm**
Aroclor-1016	ug/kg		6.5 U	6.5 U		18 U	18 U	18 U
Aroclor-1221	ug/kg		7.3 U	7.3 U		28 U	28 U	27 U
Aroclor-1232	ug/kg		11 U	11 U		20 U	19 U	19 U
Aroclor-1242	ug/kg		6.6 U	6.6 U		18 U	18 U	18 U
Aroclor-1248	ug/kg		6.7 U	6.7 U		10 U	10 U	10 U
Aroclor-1254	ug/kg		13 U	13 U		10 U	10 U	9.9 U
Aroclor-1260	ug/kg		7.8 U	7.8 U		5.5 U	5.4 U	5.4 U
Aroclor-1262	ug/kg		21 U	21 U		13 U	13 U	13 U
Aroclor-1268	ug/kg		17 U	17 U		6.5 U	6.4 U	6.3 U
								81-114 cm
Aroclor-1016	ug/kg							17 U
Aroclor-1221	ug/kg							27 U
Aroclor-1232	ug/kg							19 U
Aroclor-1242	ug/kg							17 U
Aroclor-1248	ug/kg							10 U
Aroclor-1254	ug/kg							9.7 U
Aroclor-1260	ug/kg							5.2 U
Aroclor-1262	ug/kg							13 U
Aroclor-1268	ug/kg							6.2 U

Table B-1
TABULATION OF PCB AROCLORS IN LOW RESOLUTION CORE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-RM8.1A	BB-RM8.1B	BB-RM8.3A	BB-RM8.3B
Compound	**Units**	**0-25 cm**	**0-20 cm**	**0-30 cm**	**0-23 cm**
Aroclor-1016	ug/kg	26 U	30 U	19 U	19 U
Aroclor-1221	ug/kg	39 U	47 U	29 U	29 U
Aroclor-1232	ug/kg	27 U	32 U	20 U	20 U
Aroclor-1242	ug/kg	26 U	30 U	19 U	19 U
Aroclor-1248	ug/kg	15 U	17 U	11 U	11 U
Aroclor-1254	ug/kg	14 U	100 JN	11 U	10 U
Aroclor-1260	ug/kg	100	9.1 U	5.7 U	5.7 U
Aroclor-1262	ug/kg	19 U	22 U	14 U	14 U
Aroclor-1268	ug/kg	9 U	11 U	6.8 U	6.7 U
		25-55 cm	**20-48 cm**	**30-44 cm**	**23-50 cm**
Aroclor-1016	ug/kg	19 U	31 U	22 U	23 U
Aroclor-1221	ug/kg	29 U	48 U	34 U	35 U
Aroclor-1232	ug/kg	20 U	34 U	24 U	24 U
Aroclor-1242	ug/kg	19 U	31 U	22 U	23 U
Aroclor-1248	ug/kg	11 U	18 U	13 U	13 U
Aroclor-1254	ug/kg	11 U	390 J	59	150 J
Aroclor-1260	ug/kg	5.8 U	300	6.7 U	110
Aroclor-1262	ug/kg	14 U	23 U	16 U	17 U
Aroclor-1268	ug/kg	6.8 U	11 U	7.9 U	8 U
		55-74 cm	**48-77 cm**	**44-64 cm**	**50-73 cm**
Aroclor-1016	ug/kg	19 U	19 U	22 U	20 U
Aroclor-1221	ug/kg	30 U	30 U	34 U	30 U
Aroclor-1232	ug/kg	21 U	21 U	24 U	21 U
Aroclor-1242	ug/kg	19 U	19 U	22 U	20 U
Aroclor-1248	ug/kg	11 U	11 U	13 U	11 U
Aroclor-1254	ug/kg	11 U	11 U	91	11 U
Aroclor-1260	ug/kg	5.8 U	5.8 U	30 J	5.9 U
Aroclor-1262	ug/kg	14 U	14 U	16 U	14 U
Aroclor-1268	ug/kg	6.8 U	6.8 U	7.8 U	6.9 U
		74-102 cm		**64-80 cm**	
Aroclor-1016	ug/kg	18 U		19 U	19 U
Aroclor-1221	ug/kg	28 U		30 U	29 U
Aroclor-1232	ug/kg	20 U		21 U	20 U
Aroclor-1242	ug/kg	18 U		19 U	19 U
Aroclor-1248	ug/kg	11 U		11 U	11 U
Aroclor-1254	ug/kg	10 U		11 U	15 J
Aroclor-1260	ug/kg	5.5 U		5.8 U	5.7 U
Aroclor-1262	ug/kg	14 U		14 U	14 U
Aroclor-1268	ug/kg	6.5 U		6.8 U	6.7 U
		102-125 cm			
Aroclor-1016	ug/kg	19 U			
Aroclor-1221	ug/kg	29 U			
Aroclor-1232	ug/kg	20 U			
Aroclor-1242	ug/kg	19 U			
Aroclor-1248	ug/kg	11 U			
Aroclor-1254	ug/kg	10 U			
Aroclor-1260	ug/kg	5.6 U			
Aroclor-1262	ug/kg	14 U			
Aroclor-1268	ug/kg	6.6 U			
		125-150 cm			
Aroclor-1016	ug/kg	18 U			
Aroclor-1221	ug/kg	28 U			
Aroclor-1232	ug/kg	19 U			
Aroclor-1242	ug/kg	18 U			
Aroclor-1248	ug/kg	10 U			
Aroclor-1254	ug/kg	10 U			
Aroclor-1260	ug/kg	5.4 U			
Aroclor-1262	ug/kg	13 U			
Aroclor-1268	ug/kg	6.4 U			
		150-170 cm			
Aroclor-1016	ug/kg	18 U			
Aroclor-1221	ug/kg	28 U			
Aroclor-1232	ug/kg	20 U			
Aroclor-1242	ug/kg	18 U			
Aroclor-1248	ug/kg	10 U			
Aroclor-1254	ug/kg	10 U			
Aroclor-1260	ug/kg	5.5 U			
Aroclor-1262	ug/kg	13 U			
Aroclor-1268	ug/kg	6.5 U			
		170-193 cm			
Aroclor-1016	ug/kg	18 U			
Aroclor-1221	ug/kg	27 U			
Aroclor-1232	ug/kg	19 U			
Aroclor-1242	ug/kg	18 U			
Aroclor-1248	ug/kg	10 U			
Aroclor-1254	ug/kg	9.9 U			
Aroclor-1260	ug/kg	5.4 U			
Aroclor-1262	ug/kg	13 U			
Aroclor-1268	ug/kg	6.3 U			

Notes:

Non-detected values (*i.e.*, "U" or "UJ" qualified) are presented as the Method Detection Limit.

Field duplicate samples are not presented.

Result values qualified with "U" indicate the compound was analyzed for but not detected.

Result values qualified with "J" indicate the result is estimated.

Result values qualified with "N" indicate presumed evidence of a TIC (Tentatively Identified Compound).

Result values qualified with "P" indicate a greater than 25% difference for detected Aroclor target compounds between the two GC columns. The lower of the two values is reported and flagged with a "P".

Result values qualified with "C" indicate Aroclor results that have been identified and confirmed by GC/MS.

Result values qualified with "E" indicate result values exceeding the highest standard used during the initial calibration of the analytical instrument for that specific compound.

Result values qualified with "S" indicate an estimated value for Aroclor target compounds where a valid 5-point initial calibration was not performed prior to the analyte's detection in a sample. Reanalysis of the sample is required after a valid 5-point calibration is performed.

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		G1A	G2A	G3A	G4A	G5A	G6A	G7A
Compound	**Units**	**0 - 39 cm**	**0 - 25 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 45 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1221	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1232	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1242	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1248	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1254	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1260	ug/kg	78 U	54 U	41 U	36 J	35 U	60 U	45 U
Aroclor-1262	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
Aroclor-1268	ug/kg	78 U	54 U	41 U	42 U	35 U	60 U	45 U
				30 - 60 cm	**30 - 60 cm**		**30 - 52 cm**	**30 - 49 cm**
Aroclor-1016	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1221	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1232	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1242	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1248	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1254	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1260	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1262	ug/kg			38 U	41 U		42 U	38 U
Aroclor-1268	ug/kg			38 U	41 U		42 U	38 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G8A	G9A	G10A	G11A	G12A	G13A	G14A
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 33 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1221	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1232	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1242	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1248	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1254	ug/kg	27 J	38 U	37 U	36 NJ	420 NJ	600 NJ	1700 JN
Aroclor-1260	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1262	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
Aroclor-1268	ug/kg	43 U	38 U	37 U	33 U	47 U	48 U	97 U
		30 - 60 cm	**30 - 60 cm**	**30 - 52 cm**	**30 - 55 cm**			**30 - 60 cm**
Aroclor-1016	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1221	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1232	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1242	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1248	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1254	ug/kg	39 U	50 J	37 U	33 U			7.7 J
Aroclor-1260	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1262	ug/kg	39 U	52 U	37 U	33 U			44 U
Aroclor-1268	ug/kg	39 U	52 U	37 U	33 U			44 U
								60 - 67 cm
Aroclor-1016	ug/kg							6.1 U
Aroclor-1221	ug/kg							1.9 U
Aroclor-1232	ug/kg							4.5 U
Aroclor-1242	ug/kg							3.6 U
Aroclor-1248	ug/kg							2.9 U
Aroclor-1254	ug/kg							2 U
Aroclor-1260	ug/kg							6 U
Aroclor-1262	ug/kg							2.6 U
Aroclor-1268	ug/kg							3.7 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		G15A	G16A	G17A	G18A	G19A	G20A	G21A
Compound	**Units**	**0 - 30 cm**	**0 - 37 cm**	**0 - 47 cm**	**0 - 30 cm**	**0 - 44 cm**	**0 - 42 cm**	**0 - 48 cm**
Aroclor-1016	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1221	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1232	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1242	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1248	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1254	ug/kg	410	640 J	1200 J	2200 J	320 NJ	9200 NJ	6000 J
Aroclor-1260	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1262	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
Aroclor-1268	ug/kg	42 U	41 U	52 U	57 U	41 U	160 U	160 U
		30 - 60 cm			**30 - 63 cm**			
Aroclor-1016	ug/kg	33 U			43 U			
Aroclor-1221	ug/kg	33 U			43 U			
Aroclor-1232	ug/kg	33 U			43 U			
Aroclor-1242	ug/kg	33 U			43 U			
Aroclor-1248	ug/kg	33 U			43 U			
Aroclor-1254	ug/kg	3.1 J			14 J			
Aroclor-1260	ug/kg	33 U			43 U			
Aroclor-1262	ug/kg	33 U			43 U			
Aroclor-1268	ug/kg	33 U			43 U			
		60 - 69 cm						
Aroclor-1016	ug/kg	5.8 U						
Aroclor-1221	ug/kg	1.8 U						
Aroclor-1232	ug/kg	4.2 U						
Aroclor-1242	ug/kg	3.4 U						
Aroclor-1248	ug/kg	2.7 U						
Aroclor-1254	ug/kg	1.9 U						
Aroclor-1260	ug/kg	5.6 U						
Aroclor-1262	ug/kg	2.5 U						
Aroclor-1268	ug/kg	3.5 U						

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G22A	G23A	G24A	G25A	G1B	G2B	G3B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 40 cm**	**0 - 40 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1221	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1232	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1242	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1248	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1254	ug/kg	4700 NJ	7300 NJ	11000 NJ	2400 NJ	290 J	5400 J	3400 J
Aroclor-1260	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1262	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
Aroclor-1268	ug/kg	71 U	97 U	230 U	42 U	47 U	73 U	55 U
		30 - 55 cm	**30 - 42 cm**	**40 - 46 cm**		**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	79 U	6.3 U	7.6 U		37 U	44 U	53 U
Aroclor-1221	ug/kg	79 U	1.9 U	2.3 U		37 U	44 U	53 U
Aroclor-1232	ug/kg	79 U	4.6 U	5.6 U		37 U	44 U	53 U
Aroclor-1242	ug/kg	79 U	3.7 U	4.5 U		37 U	44 U	53 U
Aroclor-1248	ug/kg	79 U	3 U	3.6 U		37 U	44 U	53 U
Aroclor-1254	ug/kg	4800 J	23 J	1800 E		4.8 J	44 U	75 J
Aroclor-1260	ug/kg	79 U	6.2 U	99 NJ		37 U	44 U	53 U
Aroclor-1262	ug/kg	79 U	2.7 U	3.3 U		37 U	44 U	53 U
Aroclor-1268	ug/kg	79 U	3.9 U	4.7 U		37 U	44 U	53 U
								61 - 83 cm
Aroclor-1016	ug/kg							8.1 U
Aroclor-1221	ug/kg							2.5 U
Aroclor-1232	ug/kg							6 U
Aroclor-1242	ug/kg							4.8 U
Aroclor-1248	ug/kg							3.8 U
Aroclor-1254	ug/kg							370
Aroclor-1260	ug/kg							42 J
Aroclor-1262	ug/kg							3.5 U
Aroclor-1268	ug/kg							5 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G4B	G5B	G6B	G7B	G8B	G9B	G10B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1221	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1232	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1242	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1248	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1254	ug/kg	5400 EP	3500 EP	22000 E	31000 E	9100 E	8400 E	570 NJ
Aroclor-1260	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1262	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
Aroclor-1268	ug/kg	55 U	62 U	260 U	380 U	190 U	190 U	54 U
		30 - 62 cm	**30 - 61 cm**	**30 - 49 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1221	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1232	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1242	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1248	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1254	ug/kg	95	63 J	67	8400 E	420 P	9500 E	49 U
Aroclor-1260	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1262	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
Aroclor-1268	ug/kg	62 U	73 U	58 U	210 U	38 U	200 U	49 U
		62 - 87 cm	**61 - 81 cm**		**61 - 85 cm**	**61 - 91 cm**	**61 - 91 cm**	
Aroclor-1016	ug/kg	6.1 U	8.5 U		5.6 U	5.7 U	13 U	
Aroclor-1221	ug/kg	1.9 U	2.6 U		1.7 U	1.7 U	4 U	
Aroclor-1232	ug/kg	4.5 U	6.2 U		4.1 U	4.2 U	9.6 U	
Aroclor-1242	ug/kg	3.6 U	5 U		3.3 U	3.4 U	7.7 U	
Aroclor-1248	ug/kg	2.9 U	4 U		2.6 U	2.7 U	6.1 U	
Aroclor-1254	ug/kg	26 J	37 J		65	20 J	6100 EC	
Aroclor-1260	ug/kg	6 U	8.3 U		5.5 U	5.6 U	500 J	
Aroclor-1262	ug/kg	2.6 U	3.6 U		2.4 U	2.4 U	5.6 U	
Aroclor-1268	ug/kg	3.8 U	5.2 U		3.4 U	3.5 U	8 U	
						91 - 97 cm	**91 - 106 cm**	
Aroclor-1016	ug/kg					5.6 U	6.8 U	
Aroclor-1221	ug/kg					1.7 U	2.1 U	
Aroclor-1232	ug/kg					4.1 U	5 U	
Aroclor-1242	ug/kg					3.3 U	4 U	
Aroclor-1248	ug/kg					2.6 U	3.2 U	
Aroclor-1254	ug/kg					25 J	40 J	
Aroclor-1260	ug/kg					5.5 U	6.7 U	
Aroclor-1262	ug/kg					2.4 U	2.9 U	
Aroclor-1268	ug/kg					3.5 U	4.2 U	

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G11B	G12B	G13B	G14B	G15B	G16B	G17B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1221	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1232	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1242	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1248	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1254	ug/kg	200 J	44 U	40 U	2600 EP	130 J		66 NJ
Aroclor-1260	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1262	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
Aroclor-1268	ug/kg	53 U	44 U	40 U	40 U	44 U	37 U	36 U
		30 - 61 cm	**30 - 53 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 62 cm**
Aroclor-1016	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1221	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1232	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1242	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1248	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1254	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1260	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1262	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
Aroclor-1268	ug/kg	39 U	36 U	37 U	38 U	38 U	37 U	38 U
					61 - 88 cm	**61 - 76 cm**		
Aroclor-1016	ug/kg				5.6 U	5.7 U		
Aroclor-1221	ug/kg				1.7 U	1.7 U		
Aroclor-1232	ug/kg				4.1 U	4.2 U		
Aroclor-1242	ug/kg				3.3 U	3.4 U		
Aroclor-1248	ug/kg				2.6 U	2.7 U		
Aroclor-1254	ug/kg				1.8 U	1.9 U		
Aroclor-1260	ug/kg				5.5 U	5.6 U		
Aroclor-1262	ug/kg				2.4 U	2.4 U		
Aroclor-1268	ug/kg				3.4 U	3.5 U		

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G1C	G2C	G3C	G4C	G5C	G6C	G1D
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	6 U
Aroclor-1221	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	1.8 U
Aroclor-1232	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	4.4 U
Aroclor-1242	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	3.5 U
Aroclor-1248	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	2.8 U
Aroclor-1254	ug/kg	750 J	330 J	170 J	360 JN	44 NJ	54 NJ	430
Aroclor-1260	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	92
Aroclor-1262	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	2.6 U
Aroclor-1268	ug/kg	39 U	43 U	40 U	63 U	38 U	39 U	3.7 U
		30 - 61 cm	**30 - 62 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	6.4 U
Aroclor-1221	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	2 U
Aroclor-1232	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	4.7 U
Aroclor-1242	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	3.8 U
Aroclor-1248	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	3 U
Aroclor-1254	ug/kg	2.5 J	5.3 J	42 U	54 U	37 U	37 U	1300 EP
Aroclor-1260	ug/kg	35 U	38 U	42 U	6.3 J	37 U	37 U	140
Aroclor-1262	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	2.8 U
Aroclor-1268	ug/kg	35 U	38 U	42 U	54 U	37 U	37 U	3.9 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	G2D	G3D	G4D	G5D	G6D	T01A	T01B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	6.1 U	5.7 U	6 U	5.8 U	5.7 U	4.4 U	3.6 U
Aroclor-1221	ug/kg	1.9 U	1.8 U	1.8 U	1.8 U	1.7 U	6.4 U	5.3 U
Aroclor-1232	ug/kg	4.5 U	4.2 U	4.4 U	4.3 U	4.2 U	5 U	4.1 U
Aroclor-1242	ug/kg	3.6 U	3.4 U	3.5 U	3.4 U	3.4 U	4.4 U	3.6 U
Aroclor-1248	ug/kg	2.9 U	2.7 U	2.8 U	2.7 U	2.7 U	3.7 U	3.1 U
Aroclor-1254	ug/kg	180	150	51	190	100	2000 E	520 J
Aroclor-1260	ug/kg	25 J	21 J	79	40	18 J	340 J	96 J
Aroclor-1262	ug/kg	2.6 U	2.5 U	2.6 U	2.5 U	2.4 U	5.1 U	4.3 U
Aroclor-1268	ug/kg	3.7 U	3.5 U	3.7 U	3.6 U	3.5 U	5.1 U	4.3 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	5.9 U	5.9 U	5.8 U	5.6 U	5.6 U	4.6 U	3.6 U
Aroclor-1221	ug/kg	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	6.7 U	5.3 U
Aroclor-1232	ug/kg	4.4 U	4.3 U	4.2 U	4.1 U	4.1 U	5.2 U	4.1 U
Aroclor-1242	ug/kg	3.5 U	3.5 U	3.4 U	3.3 U	3.3 U	4.6 U	3.6 U
Aroclor-1248	ug/kg	2.8 U	2.8 U	2.7 U	2.6 U	2.6 U	3.9 U	3.1 U
Aroclor-1254	ug/kg	85 J	170 J	110 J	30 J	1.8 U	41 J	5.3 U
Aroclor-1260	ug/kg	18 J	27 J	63	37 J	5.5 U	12 J	3.7 U
Aroclor-1262	ug/kg	2.5 U	2.5 U	2.5 U	2.4 U	2.4 U	5.4 U	4.2 U
Aroclor-1268	ug/kg	3.6 U	3.6 U	3.5 U	3.4 U	3.4 U	5.4 U	4.2 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		T01C	T02A	T02B	T02C	T02D	T02E	T03A
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	4.3 U	5.9 U	3.5 U	3.7 U	3.6 U	6 U	5.7 U
Aroclor-1221	ug/kg	6.3 U	1.8 U	5.2 U	5.5 U	5.2 U	1.8 U	1.7 U
Aroclor-1232	ug/kg	4.9 U	4.3 U	4.1 U	4.3 U	4.1 U	4.4 U	4.2 U
Aroclor-1242	ug/kg	4.3 U	3.5 U	3.5 U	3.7 U	3.6 U	3.6 U	3.4 U
Aroclor-1248	ug/kg	3.7 U	2.8 U	3 U	3.2 U	3.1 U	2.8 U	2.7 U
Aroclor-1254	ug/kg	150 J	59	26 J	700 E	49 J	17 J	1.9 U
Aroclor-1260	ug/kg	39 J	31 J	11 J	110 J	3.7 U	15 J	8.1 J
Aroclor-1262	ug/kg	5.1 U	2.5 U	4.2 U	4.4 U	4.2 U	2.6 U	2.4 U
Aroclor-1268	ug/kg	5.1 U	3.6 U	4.2 U	4.4 U	4.2 U	3.7 U	3.5 U
		30 - 61 cm	**30 - 67 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	3.5 U	5.7 U	3.4 U	4 U	4.2 U	6 U	5.6 U
Aroclor-1221	ug/kg	5.1 U	1.7 U	5 U	5.9 U	6.1 U	1.8 U	1.7 U
Aroclor-1232	ug/kg	4 U	4.2 U	3.9 U	4.6 U	4.8 U	4.4 U	4.1 U
Aroclor-1242	ug/kg	3.5 U	3.4 U	3.4 U	4 U	4.2 U	3.6 U	3.3 U
Aroclor-1248	ug/kg	3 U	2.7 U	2.9 U	3.5 U	3.6 U	2.8 U	2.6 U
Aroclor-1254	ug/kg	5.1 U	1.9 U	5 U	320	6.1 U	2 U	110
Aroclor-1260	ug/kg	3.6 U	5.6 U	3.6 U	45 J	4.3 U	5.9 U	35 J
Aroclor-1262	ug/kg	4.1 U	2.4 U	4 U	4.8 U	4.9 U	2.6 U	2.4 U
Aroclor-1268	ug/kg	4.1 U	3.5 U	4 U	4.8 U	4.9 U	2.6 J	3.4 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	T03B	T03C	T03D	T03B	T03E	T04A	T04B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**30 - 61 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	6.8 U	6.2 U	6.2 U	5.6 U	6.5 U	3.9 U	4.1 U
Aroclor-1221	ug/kg	2.1 U	1.9 U	1.9 U	1.7 U	2 U	5.7 U	6 U
Aroclor-1232	ug/kg	5 U	4.6 U	4.6 U	4.1 U	4.8 U	4.5 U	4.7 U
Aroclor-1242	ug/kg	4 U	3.7 U	3.7 U	3.3 U	3.8 U	3.9 U	4.1 U
Aroclor-1248	ug/kg	3.2 U	2.9 U	2.9 U	2.6 U	3 U	3.4 U	3.5 U
Aroclor-1254	ug/kg	610 E	1100 E	210 J	1.8 U	240	63 NJ	330
Aroclor-1260	ug/kg	86 J	150	56	5.5 U	48	23 J	46 J
Aroclor-1262	ug/kg	2.9 U	2.7 U	2.7 U	2.4 U	2.8 U	4.6 U	4.8 U
Aroclor-1268	ug/kg	4.2 U	3.8 U	3.8 U	3.4 U	4 U	4.6 U	4.8 U
		30 - 61 cm	**30 - 61 cm**			**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	6 U	6.9 U			5.6 U	3.2 U	3.6 U
Aroclor-1221	ug/kg	1.8 U	2.1 U			1.7 U	4.7 U	5.3 U
Aroclor-1232	ug/kg	4.4 U	5 U			4.1 U	3.7 U	4.2 U
Aroclor-1242	ug/kg	3.6 U	4.1 U			3.3 U	3.2 U	3.6 U
Aroclor-1248	ug/kg	2.8 U	3.2 U			2.6 U	2.8 U	3.1 U
Aroclor-1254	ug/kg	27 J	63			1.8 U	4.7 U	5.3 U
Aroclor-1260	ug/kg	7.4 J	10 J			5.5 U	3.3 U	3.8 U
Aroclor-1262	ug/kg	2.6 U	2.9 U			2.4 U	3.8 U	4.3 U
Aroclor-1268	ug/kg	3.7 U	4.2 U			3.4 U	3.8 U	4.3 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	T04C	T05A	T05B	T05C	T06A	T06B	T06C
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	3.2 U	3.5 U	3.8 U	3.3 U	6.1 U	3.4 U	3.4 U
Aroclor-1221	ug/kg	4.6 U	5.2 U	5.5 U	4.8 U	1.9 U	5 U	5 U
Aroclor-1232	ug/kg	3.6 U	4 U	4.3 U	3.7 U	4.5 U	3.9 U	3.9 U
Aroclor-1242	ug/kg	3.2 U	3.5 U	3.8 U	3.3 U	3.6 U	3.4 U	3.4 U
Aroclor-1248	ug/kg	2.7 U	3 U	3.2 U	2.8 U	2.8 U	2.9 U	2.9 U
Aroclor-1254	ug/kg	54	1500 E	330	4.8 U	36 J	30 J	27 J
Aroclor-1260	ug/kg	12 J	160 J	51 J	13 J	5.9 U	9.1 J	8 J
Aroclor-1262	ug/kg	3.7 U	4.1 U	4.4 U	3.9 U	2.6 U	4 U	4 U
Aroclor-1268	ug/kg	3.7 U	4.1 U	4.4 U	3.9 U	3.7 U	4 U	4 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	3.4 U	3.6 U	3.4 U	3.2 U	5.6 U	3.1 U	3.1 U
Aroclor-1221	ug/kg	4.9 U	5.3 U	4.9 U	4.7 U	1.7 U	4.6 U	4.6 U
Aroclor-1232	ug/kg	3.8 U	4.1 U	3.8 U	3.7 U	4.1 U	3.6 U	3.6 U
Aroclor-1242	ug/kg	3.4 U	3.6 U	3.4 U	3.2 U	3.3 U	3.1 U	3.1 U
Aroclor-1248	ug/kg	2.9 U	3.1 U	2.9 U	2.8 U	2.6 U	2.7 U	2.7 U
Aroclor-1254	ug/kg	910 E	1200 E	4.9 U	84	1.8 U	4.6 U	4.6 U
Aroclor-1260	ug/kg	71 J	92 J	3.5 U	45	5.5 U	3.3 U	3.2 U
Aroclor-1262	ug/kg	4 U	4.2 U	3.9 U	3.8 U	2.4 U	3.7 U	3.7 U
Aroclor-1268	ug/kg	4 U	4.2 U	3.9 U	3.8 U	3.4 U	3.7 U	3.7 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		T07A	T07B	T07C	T08A	T08B	T09A	T09B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 15 cm**	**0 - 15 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	3.5 U	4.5 U	3.9 U	5.8 U	6.2 U	4.3 U	5.8 U
Aroclor-1221	ug/kg	5.1 U	6.7 U	5.7 U	6.6 U	7 U	6.4 U	1.8 U
Aroclor-1232	ug/kg	4 U	5.2 U	4.5 U	9.6 U	10 U	5 U	4.3 U
Aroclor-1242	ug/kg	3.5 U	4.5 U	3.9 U	6 U	6.3 U	4.3 U	3.4 U
Aroclor-1248	ug/kg	3 U	3.9 U	3.4 U	6.1 U	6.5 U	3.7 U	2.7 U
Aroclor-1254	ug/kg	120	3400 E	1400 E	11 U	12 U	660 E	1.9 U
Aroclor-1260	ug/kg	27 J	330	130 J	7.1 U	7.5 U	94 J	5.7 U
Aroclor-1262	ug/kg	4.1 U	5.4 U	4.6 U	19 U	20 U	5.1 U	2.5 U
Aroclor-1268	ug/kg	4.1 U	5.4 U	4.6 U	15 U	16 U	5.1 U	3.6 U
		30 - 64 cm	**30 - 61 cm**	**30 - 61 cm**			**30 - 68 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	3.5 U	3.7 U	3.3 U			5.9 U	5.3 U
Aroclor-1221	ug/kg	5.2 U	5.4 U	4.8 U			1.8 U	1.6 U
Aroclor-1232	ug/kg	4 U	4.2 U	3.7 U			4.4 U	3.9 U
Aroclor-1242	ug/kg	220	3.7 U	3.3 U			3.5 U	3.1 U
Aroclor-1248	ug/kg	3 U	3.2 U	2.8 U			2.8 U	2.5 U
Aroclor-1254	ug/kg	270 J	28 J	17 J			1.9 U	1.7 U
Aroclor-1260	ug/kg	95	3.8 U	3.1 J			5.8 U	5.2 U
Aroclor-1262	ug/kg	4.2 U	4.4 U	3.9 U			2.5 U	2.3 U
Aroclor-1268	ug/kg	4.2 U	4.4 U	3.9 U			3.6 U	3.2 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	T10A	T10B	T11A	T11B	T11C	T11D	T12A
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	6.3 UJ	5.9 UJ	4.2 U	4.3 U	3.8 U	4.3 U	7.6 U
Aroclor-1221	ug/kg	7.2 U	6.7 U	6.2 U	6.3 U	5.6 U	6.2 U	8.6 U
Aroclor-1232	ug/kg	10 U	9.8 U	4.8 U	4.9 U	4.4 U	4.9 U	13 U
Aroclor-1242	ug/kg	6.5 U	6 U	4.2 U	4.3 U	3.8 U	4.3 U	7.7 U
Aroclor-1248	ug/kg	6.6 U	6.2 U	3.6 U	3.7 U	3.3 U	3.7 U	7.9 U
Aroclor-1254	ug/kg	12 U	12 U	590 J	1700 J	2100 J	500	810 NJ
Aroclor-1260	ug/kg	7.7 U	7.1 U	640 J	730 J	360 J	72 J	260 DJ
Aroclor-1262	ug/kg	20 U	19 U	5 U	5.1 U	4.5 U	5 U	24 U
Aroclor-1268	ug/kg	17 U	15 U	220 J	330 J	4.5 U	5 U	20 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 55 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	5.9 UJ	5.8 UJ	4 U	4 U	3.8 U	7.3 U	7.3 U
Aroclor-1221	ug/kg	6.7 U	6.5 U	5.9 U	5.8 U	5.6 U	11 U	8.3 U
Aroclor-1232	ug/kg	9.8 U	9.5 U	4.6 U	4.5 U	4.4 U	8.3 U	12 U
Aroclor-1242	ug/kg	6 U	5.9 U	4 U	4 U	3.8 U	7.3 U	7.5 U
Aroclor-1248	ug/kg	6.2 U	6 U	3.4 U	3.4 U	3.3 U	6.2 U	7.6 U
Aroclor-1254	ug/kg	12 U	11 U	470 J	160 J	2200 E	910	14 U
Aroclor-1260	ug/kg	7.1 U	7 U	3500 E	810 J	390 J	7.5 U	8.9 U
Aroclor-1262	ug/kg	19 U	19 U	4.7 U	4.7 U	4.5 U	8.6 U	24 U
Aroclor-1268	ug/kg	15 U	15 U	1000 J	210 J	4.5 U	8.6 U	19 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		T12B	T12C	T12D	T13A	T13B	T14A	T14B
Compound	**Units**	**0 - 39 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	7.1 U	7.3 U	7.4 U	3.7 U	7.7 U	7.9 UJ	7 U
Aroclor-1221	ug/kg	8 U	8.2 U	8.4 U	5.4 U	8.7 U	9 U	7.9 U
Aroclor-1232	ug/kg	12 U	12 U	12 U	4.2 U	13 U	13 U	11 U
Aroclor-1242	ug/kg	7.2 U	7.4 U	7.6 U	3.7 U	7.9 U	8.1 U	7.1 U
Aroclor-1248	ug/kg	7.4 U	7.6 U	7.7 U	3.2 U	8.1 U	8.3 U	7.2 U
Aroclor-1254	ug/kg	14 U	14 U		5.4 U	2900 PE	6300 PE	93 NJ
Aroclor-1260	ug/kg	8.5 U	8.8 U	73 J	3.8 U	340 NJ	1100 J	25 J
Aroclor-1262	ug/kg	23 U	23 U	24 U	4.4 U	25 U	26 U	22 U
Aroclor-1268	ug/kg	18 U	19 U	19 U	4.4 U	20 U	21 U	18 U
			30 - 64 cm	**30 - 64 cm**	**30 - 69 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 55 cm**
Aroclor-1016	ug/kg		6.6 U	6.4 U	5.5 U	6.4 U	6.6 UJ	6.3 U
Aroclor-1221	ug/kg		7.5 U	7.3 U	8.1 U	7.2 U	7.4 U	7.1 U
Aroclor-1232	ug/kg		11 U	11 U	6.3 U	11 U	11 U	10 U
Aroclor-1242	ug/kg		6.8 U	6.6 U	5.5 U	6.5 U	6.7 U	6.4 U
Aroclor-1248	ug/kg		6.9 U	6.7 U	4.7 U	6.7 U	6.8 U	6.5 U
Aroclor-1254	ug/kg		13 U	50 J	4900 E	91	53	12 U
Aroclor-1260	ug/kg		8 U	71 J	440 J	17 J	7.9 U	7.6 U
Aroclor-1262	ug/kg		21 U	21 U	6.5 U	21 U	21 U	20 U
Aroclor-1268	ug/kg		17 U	17 U	6.5 U	17 U	17 U	16 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		T15A	T16A	T16B	T16C	T17A	T17B	T17C
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	6.1 U	5.4 U	3.8 U	4.8 U	6.8 UJ	32 U	63 U
Aroclor-1221	ug/kg	6.9 U	7.9 U	5.6 U	7 U	7.7 U	36 U	92 U
Aroclor-1232	ug/kg	10 U	6.2 U	4.4 U	5.5 U	11 U	53 U	72 U
Aroclor-1242	ug/kg	6.2 U	5.4 U	150	4.8 U	6.9 U	33 U	63 U
Aroclor-1248	ug/kg	6.4 U	4.6 U	3.3 U	4.1 U	7.1 U	33 U	54 U
Aroclor-1254	ug/kg	1700 E	3900 E	1200 E	300	100 NJ	62000 E	50000 EC
Aroclor-1260	ug/kg	140 J	330 J	140 J	79 J	25 J	39 U	65 U
Aroclor-1262	ug/kg	20 U	6.3 U	4.5 U	5.7 U	22 U	100 U	74 U
Aroclor-1268	ug/kg	16 U	6.3 U	4.5 U	5.7 U	18 U	83 U	74 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 47 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	6.1 U	3.6 U	4.3 U	4.8 U	6.1 UJ	6.5 U	3.1 U
Aroclor-1221	ug/kg	6.9 U	5.3 U	6.3 U	7 U	6.9 U	7.3 U	4.6 U
Aroclor-1232	ug/kg	10 U	4.1 U	4.9 U	5.5 U	10 U	11 U	3.6 U
Aroclor-1242	ug/kg	6.2 U	3.6 U	4.3 U	4.8 U	6.3 U	6.6 U	610 EP
Aroclor-1248	ug/kg	6.3 U	3.1 U	3.7 U	4.1 U	6.4 U	6.7 U	2.7 U
Aroclor-1254	ug/kg	40	43	1100 E	700 E	12 U	23 J	700 EP
Aroclor-1260	ug/kg	7.4 U	6 J	88 NJ	190 J	7.4 U	7.8 U	53 J
Aroclor-1262	ug/kg	20 U	4.2 U	5.1 U	5.7 U	20 U	21 U	3.7 U
Aroclor-1268	ug/kg	16 U	4.2 U	5.1 U	5.7 U	16 U	17 U	3.7 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	T17D	T18A	T18B	T19A	T19B	T19C	T20A
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	6.4 U	3.2 U	6.9 U	19 U	18 U	17 U	21 U
Aroclor-1221	ug/kg	7.2 U	4.8 U	7.8 U	30 U	28 U	27 U	33 U
Aroclor-1232	ug/kg	11 U	3.7 U	11 U	21 U	19 U	18 U	23 U
Aroclor-1242	ug/kg	6.5 U	3.2 U	7 U	19 U	18 U	17 U	21 U
Aroclor-1248	ug/kg	6.7 U	2.8 U	7.1 U	11 U	10 U	9.9 U	12 U
Aroclor-1254	ug/kg	1000 J	300	490	87 NJ	10 U	50 J	12 U
Aroclor-1260	ug/kg	140	45 J	74	49 NJ	5.5 UJ	74	34 J
Aroclor-1262	ug/kg	21 U	3.8 U	22 U	14 U	13 U	13 U	16 U
Aroclor-1268	ug/kg	17 U	3.8 U	18 U	6.9 U	6.4 U	6.1 U	7.5 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	6.8 U	3.2 U	6.4 U	18 U	18 U	17 U	19 U
Aroclor-1221	ug/kg	7.7 U	4.7 U	7.2 U	27 U	27 U	26 U	30 U
Aroclor-1232	ug/kg	11 U	3.6 U	11 U	19 U	19 U	18 U	21 U
Aroclor-1242	ug/kg	7 U	3.2 U	6.5 U	18 U	18 U	17 U	19 U
Aroclor-1248	ug/kg	7.1 U	2.7 U	6.7 U	10 U	10 U	9.9 U	11 U
Aroclor-1254	ug/kg	1400 J	16 J	130 NJ	9.7 U	9.9 U	27 J	11 U
Aroclor-1260	ug/kg	160	6.7 J	52	5.3 U	5.3 U	32 J	5.8 U
Aroclor-1262	ug/kg	22 U	3.8 U	21 U	13 U	13 U	13 U	14 U
Aroclor-1268	ug/kg	18 U	3.8 U	17 U	6.2 U	6.3 U	6.1 U	6.8 U

Table B-2
TABULATION OF PCB AROCLORS IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	T20B	T20C	T21A	T21B	T22A	T22B	T23A	T23B
Compound	**Units**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**	**0 - 30 cm**
Aroclor-1016	ug/kg	20 U	19 U	23 UJ	24 U	22 U	24 U	22 U	20 U
Aroclor-1221	ug/kg	30 U	29 U	36 UJ	37 U	33 U	37 U	33 U	31 U
Aroclor-1232	ug/kg	21 U	20 U	25 UJ	26 U	23 U	26 U	23 U	21 U
Aroclor-1242	ug/kg	20 U	19 U	23 UJ	24 U	22 U	24 U	22 U	20 U
Aroclor-1248	ug/kg	11 U	11 U	13 UJ	14 U	12 U	14 U	12 U	12 U
Aroclor-1254	ug/kg	21 J	42 NJ	24 J	13 U	12 U	13 U	12 U	11 U
Aroclor-1260	ug/kg	14 J	50 J	7 UJ	21 J	6.5 U	48 J	73 NJ	40 J
Aroclor-1262	ug/kg	14 U	14 U	17 UJ	18 U	16 U	18 U	16 U	15 U
Aroclor-1268	ug/kg	6.9 U	6.6 U	8.3 UJ	8.5 U	7.6 U	8.5 U	7.6 U	7.1 U
		30 - 61 cm	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**	**30 - 61 cm**
Aroclor-1016	ug/kg	18 U	18 UJ	23 U	20 U	19 U	21 U	22 U	18 U
Aroclor-1221	ug/kg	28 U	27 UJ	35 U	31 U	29 U	32 U	34 U	27 U
Aroclor-1232	ug/kg	19 U	19 UJ	24 U	22 U	20 U	23 U	24 U	19 U
Aroclor-1242	ug/kg	18 U	18 UJ	23 U	20 U	19 U	21 U	22 U	18 U
Aroclor-1248	ug/kg	10 U	10 UJ	13 U	12 U	11 U	12 U	13 U	10 U
Aroclor-1254	ug/kg	10 U	24 J	13 U	11 U	10 U	12 U	12 U	9.7 U
Aroclor-1260	ug/kg	5.4 U	5.4 UJ	6.8 U	6.1 U	5.6 U	6.4 U	66 NJ	5.3 U
Aroclor-1262	ug/kg	13 U	13 UJ	17 U	15 U	14 U	16 U	16 U	13 U
Aroclor-1268	ug/kg	6.4 U	6.3 UJ	8 U	7.2 U	6.6 U	7.5 U	7.9 U	6.2 U

Notes:

Non-detected values (*i.e.* , "U" or "UJ" qualified) are presented as the Method Detection Limit.
Field duplicate samples are not presented.
Result values qualified with "U" indicate the compound was analyzed for but not detected.
Result values qualified with "J" indicate the result is estimated.
Result values qualified with "N" indicate presumed evidence of a TIC (Tentatively Identified Compound).
Result values qualified with "P" indicate a greater than 25% difference for detected Aroclor target compounds between the two GC columns. The lower of the two values is reported and flagged with a "P".
Result values qualified with "C" indicate Aroclor results that have been identified and confirmed by GC/MS.
Result values qualified with "E" indicate result values exceeding the highest standard used during the initial calibration of the analytical instrument for that specific compound.
Result values qualified with "S" indicate an estimated value for Aroclor target compounds where a valid 5-point initial calibration was not performed prior to the analyte's detection in a sample. Reanalysis of the sample is required after a valid 5-point calibration is performed.

TABLE B-3
TABULATION OF PCB AROCLORS IN VETERANS MEMORIAL PARK
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Location:		SD-VMP01		SD-VMP02		SD-VMP02 (Field Duplicate)		SD-VMP03		SL-VMP01		SL-VMP02	
Sample Depth:		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in	
Matrix:		Sediment		Sediment		Sediment		Sediment		Soil		Soil	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Aroclor-1016	ug/kg	1200	UM	920	UM	1100	UM	990	UM	6.6	UL	23	UL
Aroclor-1221	ug/kg	890	UM	700	UM	820	UM	760	UM	5.1	U	18	UM
Aroclor-1232	ug/kg	680	UM	540	UM	630	UM	580	UM	3.9	U	14	UM
Aroclor-1242	ug/kg	1400	UM	1100	UM	1300	UM	1200	UM	7.9	U	28	UM
Aroclor-1248	ug/kg	410	UM	5600	EH	7300	EH	9500	EH	2.4	U	8.4	UM
Aroclor-1254	ug/kg	48000	M	15000	EH	20000	EH	26000	EH	42		390	M
Aroclor-1260	ug/kg	4600	E	1700	EH	2300	EH	2600	EH	32	EL	180	EL
Aroclor-1262	ug/kg	310	UM	250	UM	290	UM	260	UM	1.8	U	6.3	UM
Aroclor-1268	ug/kg	290	UM	230	UM	270	UM	250	UM	1.7	U	5.9	UM

TABLE B-3
TABULATION OF PCB AROCLORS IN VETERANS MEMORIAL PARK
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Location:	SL-VMP03		SL-VMP04		SL-VMP05		SL-VMP06		SL-VMP07		SL-VMP08	
	Sample Depth:	0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in	
	Matrix:	Soil		Soil		Soil		Soil		Soil		Soil	
Compound	**Units**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
Aroclor-1016	ug/kg	49	UL	6.4	UL	60	UL	13	UL	6.7	UL	6.8	UL
Aroclor-1221	ug/kg	37	UM	4.9	U	46	U	9.7	U	5.1	U	5.2	U
Aroclor-1232	ug/kg	29	UM	3.8	U	35	U	7.4	U	3.9	U	4	U
Aroclor-1242	ug/kg	58	UM	7.6	U	72	U	15	U	8	U	8.1	U
Aroclor-1248	ug/kg	17	UM	2.3	U	21	U	4.5	U	2.4	U	2.4	U
Aroclor-1254	ug/kg	310	M	110		770		270		69		58	
Aroclor-1260	ug/kg	140	EL	60	EL	140	EL	56	EL	29	EL	18	EL
Aroclor-1262	ug/kg	13	UM	1.7	U	16	U	3.4	U	1.8	U	1.8	U
Aroclor-1268	ug/kg	12	UM	1.6	U	15	U	3.2	U	1.7	U	1.7	U

TABLE B-3
TABULATION OF PCB AROCLORS IN VETERANS MEMORIAL PARK
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Location:	SL-VMP09		SL-VMP10		SL-VMP11		SL-VMP12		SL-VMP13		SL-VMP14	
	Sample Depth:	0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in	
	Matrix:	Soil		Soil		Soil		Soil		Soil		Soil	
Compound	**Units**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
Aroclor-1016	ug/kg	6.2	UL	1200	UL	1800	UL	1700	UL	2200	UL	1600	UL
Aroclor-1221	ug/kg	4.8	U	930	UM	1300	U	1300	U	1700	U	1200	U
Aroclor-1232	ug/kg	3.7	U	710	UM	1000	U	1000	U	1300	U	950	U
Aroclor-1242	ug/kg	7.4	U	1500	UM	2100	U	2000	U	2700	U	1900	U
Aroclor-1248	ug/kg	2.2	U	430	UM	630	U	610	U	800	U	580	U
Aroclor-1254	ug/kg	60		25000	M	47000		45000		70000		41000	
Aroclor-1260	ug/kg	22	EL	2200	EL	4500	EL	4200	EL	7400	EL	3600	EL
Aroclor-1262	ug/kg	1.7	U	320	UM	470	U	450	U	600	U	430	U
Aroclor-1268	ug/kg	1.6	U	300	UM	440	U	420	U	560	U	400	U

TABLE B-3
TABULATION OF PCB AROCLORS IN VETERANS MEMORIAL PARK
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Location:		SL-VMP14 (Field Duplicate)		SL-VMP15		SL-VMP16		SL-VMP17		SL-VMP18		SL-VMP19	
Sample Depth:		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in		0 - 6 in	
Matrix:		Soil		Soil		Soil		Soil		Soil		Soil	
Compound	**Units**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
Aroclor-1016	ug/kg	1500	UL	6.2	UL	6.3	UL	7	UL	120	UL	1400	UL
Aroclor-1221	ug/kg	1200	U	4.8	U	4.8	U	5.3	U	93	U	1100	U
Aroclor-1232	ug/kg	900	U	3.7	U	3.7	U	4.1	U	71	U	810	U
Aroclor-1242	ug/kg	1800	U	7.5	U	7.6	U	8.3	U	140	U	1600	U
Aroclor-1248	ug/kg	540	U	2.2	U	2.3	U	2.5	U	43	U	490	U
Aroclor-1254	ug/kg	35000		70	E	100	E	110	E	1800		32000	
Aroclor-1260	ug/kg	3200	EL	26	EL	29	EL	22	EL	220	EL	2600	EL
Aroclor-1262	ug/kg	410	U	1.7	U	1.7	U	1.9	U	32	U	370	U
Aroclor-1268	ug/kg	380	U	1.6	U	1.6	U	1.7	U	30	U	340	U

TABLE B-3
TABULATION OF PCB AROCLORS IN VETERANS MEMORIAL PARK
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Location:	SL-VMP20		SL-VMP21		SL-VMP22	
	Sample Depth:	0 - 6 in		0 - 6 in		0 - 6 in	
	Matrix:	Soil		Soil		Soil	
Compound	**Units**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
Aroclor-1016	ug/kg	66	UL	2400	UL	1600	UL
Aroclor-1221	ug/kg	50	U	1900	U	1200	U
Aroclor-1232	ug/kg	39	U	1400	U	950	U
Aroclor-1242	ug/kg	79	U	2900	U	1900	U
Aroclor-1248	ug/kg	23	U	860	U	570	U
Aroclor-1254	ug/kg	680		68000		32000	
Aroclor-1260	ug/kg	97	EL	6200	EL	2400	EL
Aroclor-1262	ug/kg	18	U	650	U	430	U
Aroclor-1268	ug/kg	16	U	600	U	400	U

Notes:
Non-detected values (i.e., "U", "UL", or "UM" qualified) are presented as the Method Detection Limit.
Result values qualified with "U" indicate the compound was analyzed for but not detected.
Result values qualified with "E" indicate the result was approximate (estimated) due to limitations identified during the QA/QC review.
Result values qualified with "L" indicate the result was biased low.
Result values qualified with "H" indicate the result was biased high.
Result values qualified with "M" indicate percent moisture of sample was greater than 50%.

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	TRB-NEWBRUN		TRB-NEWBRUN		TRB-NEWBRUN		TRB-ELSIE		TRB-ELSIE		TRB-SPRING		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A	
	Sample Depth:	0-15 cm		15-45 cm		45-58 cm		0-15 cm		15-32 cm		0-21 cm		0-25 cm		25-55 cm		55-74 cm		74-102 cm		102-125 cm		125-150 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Metals and Cyanide																									
Aluminum	mg/kg	5750		7280		7580		3700	J	3490	J	7390		12900		7180		7760		8760		6570		7990	
Antimony	mg/kg	0.01	UJ	0.01	UJ	0.01	UJ	0.01	UJ	0.01	UJ	0.01	U	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ
Arsenic	mg/kg	2.6	J	0.004	UJ	0.004	UJ	0.004	UJ	0.85	J	0.88	J	6.3	D	8	D	8.6	D	1.2	D	12.2	D	2	D
Barium	mg/kg	79.6		49		48.6		38.2		58.1		55		91	D	25.3	D	24.1	D	29.6	D	25.2	D	16.3	D
Beryllium	mg/kg	0.004	U	0.004	U	0.004	U	0.004	UJ	0.004	UJ	0.004	UJ	0.025	U	0.025	U	0.025	U	0.52	D	0.51	D	0.025	U
Cadmium	mg/kg	0.7		0.002	UJ	0.002	UJ	0.002	U	0.82		0.81		13.1	D	0.031	U	0.031	U	0.031	U	0.031	U	0.031	U
Calcium	mg/kg	2180		865		710		2200		2590		3820		3780		1470		1430		1520		1240		1530	
Chromium	mg/kg	8.7	J	7.9	J	10.5	J	6.7	J	10	J	12.5	J	33.8	J	10.3	J	12.2	J	14.4	J	15.8	J	8	J
Cobalt	mg/kg	3.6		2.2		2.9		3.5	J	3.6	J	4.8	J	6.1	D	4.6	D	5.9	D	6.3	D	6	D	4.1	D
Copper	mg/kg	18.8	J	3.1	J	2.3	J	9.1	J	11.2	J	26.9	J	75.2	J	8.3	J	6.5	J	7.1	J	11.9	J	5.5	J
Cyanide	mg/kg	0.84	J	0.004	UJ	0.004	UJ	0.004	U	0.004	U	1.3		0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U
Iron	mg/kg	11600		6510		8490		8580	J	8780	J	16700		15700	J	12500	J	16400	J	15800	J	14600	J	15400	J
Lead	mg/kg	95.1		14.9		9.1		16.2	J	33.7	J	66.1	J	234	D	19.4	D	5.9	D	7.2	D	4.3	D	3.7	D
Magnesium	mg/kg	2110		1940		3070		2150	J	2100	J	4150		4040		3140		3980		4170		3300		3710	
Manganese	mg/kg	124	J	43.6	J	49.9	J	81	J	179	J	118	J	73.1	J	51.9	J	70.1	J	91.5	J	75.6	J	63.3	J
Mercury	mg/kg	0.001	U	0.001	U	0.001	U	0.001	U	0.77		0.001	U	0.44		0.0022	U	0.0022	U	0.0022	U	0.0022	U	0.0022	U
Nickel	mg/kg	7.4	J	5.5	J	7.5	J	7.3	J	8.4	J	11.1	J	28.7	D	10.3	D	12.2	D	15.5	D	13.3	D	9.1	D
Potassium	mg/kg	3.5	UJ	645	J	1120	J	569	J	394	J	1070		2000		1630		1820		2170		1700		1920	
Selenium	mg/kg	0.034	UJ	0.034	UJ	0.034	UJ	0.034	UJ	0.034	UJ	0.034	UJ	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
Silver	mg/kg	0.001	U	0.001	U	0.001	U	0.72		1.2		0.001	U	8.4	D	0.57	D	0.015	U	0.015	U	0.015	U	0.015	U
Sodium	mg/kg	73.7	J	59.1	J	49.1	J	165	J	179	J	415	J	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U
Thallium	mg/kg	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U
Vanadium	mg/kg	15		11.4		10.9		7.8	J	7.6	J	13.9	J	40.2	J	38.7	J	39.6	J	16	J	44.8	J	12.1	J
Zinc	mg/kg	87.3	J	18.8	J	15.5	J	46.9	J	84.7	J	63.5	J	177	J	29.3	J	31.1	J	39.2	J	39.1	J	22.3	J
PCB Aroclors																									
Aroclor-1016	ug/kg	6.9	U	6.4	U	6.3	U	6.2	U	6.1	U	6.1	U	26	U	19	U	19	U	18	U	19	U	18	U
Aroclor-1221	ug/kg	7.8	U	7.2	U	7.1	U	7	U	6.9	U	6.9	U	39	U	29	U	30	U	28	U	29	U	28	U
Aroclor-1232	ug/kg	11	U	11	U	10	U	10	U	10	U	10	U	27	U	20	U	21	U	20	U	20	U	19	U
Aroclor-1242	ug/kg	7	U	6.5	U	6.4	U	6.4	U	6.2	U	6.3	U	26	U	19	U	19	U	18	U	19	U	18	U
Aroclor-1248	ug/kg	7.2	U	6.7	U	6.5	U	6.5	U	6.3	U	6.4	U	15	U	11	U	11	U	11	U	11	U	10	U
Aroclor-1254	ug/kg	13	U	12	U	12	U	12	U	120	J	57	NJ	14	U	11	U	11	U	10	U	10	U	10	U
Aroclor-1260	ug/kg	8.3	U	7.7	U	7.6	U	7.5	U	7.3	U	7.4	U	100		5.8	U	5.8	U	5.5	U	5.6	U	5.4	U
Aroclor-1262	ug/kg	22	U	21	U	20	U	20	U	20	U	20	U	19	U	14	U	14	U	14	U	14	U	13	U
Aroclor-1268	ug/kg	18	U	17	U	16	U	16	U	16	U	16	U	9	U	6.8	U	6.8	U	6.5	U	6.6	U	6.4	U
Pesticides																									
4,4'-DDD	ug/kg	39	J	23	J	0.9	U	0.9	UJ	4.1	J	4.5	J	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4,4'-DDE	ug/kg			2.4	J	0.92	U	0.92	UJ	0.9	UJ	5.1	NJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4,4'-DDT	ug/kg	9.7	J	1.4	U	1.4	U	1.4	UJ	1.3	UJ	4.5	NJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Aldrin	ug/kg	1.5	J	0.54	U	0.53	U	0.53	UJ	0.51	UJ	0.52	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
alpha-BHC	ug/kg	0.49	U	0.46	U	0.44	U	0.44	UJ	0.43	UJ	0.44	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
alpha-Chlordane	ug/kg	11	NJ	0.49	U	0.48	U	0.48	UJ	0.47	UJ	4.7	NJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
beta-BHC	ug/kg	0.79	U	0.74	U	0.72	U	0.72	UJ			0.71	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
delta-BHC	ug/kg	0.53	U	0.49	U	0.48	U	0.48	UJ	0.47	UJ	0.47	UJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dieldrin	ug/kg	1	UJ	0.97	U	0.95	U	0.94	UJ	0.92	UJ	0.93	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan I	ug/kg	0.48	U	0.44	U	0.43	U	0.43	UJ	0.42	UJ	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan II	ug/kg	0.87	U	0.81	U	0.79	U	1	J	0.77	UJ	0.78	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan sulfate	ug/kg	1.1	U	1	U	0.99	U	0.99	UJ	0.97	UJ	0.98	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin	ug/kg	0.99	U	0.92	U	0.9	U	0.9	UJ	0.88	UJ	0.88	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin aldehyde	ug/kg	1.5	U	1.4	U	1.3	U	1.3	UJ	1.3	UJ	1.3	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin ketone	ug/kg	10	J	0.91	U	0.89	U	0.88	UJ	0.86	UJ	0.87	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
gamma-BHC (Lindane)	ug/kg	0.48	U	0.44	U	0.43	U	0.43	UJ	0.42	UJ	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
gamma-Chlordane	ug/kg	13	J	0.53	U	0.52	U	0.51	UJ			7.6	NJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Heptachlor	ug/kg	0.74	U	0.69	U	0.67	U	0.67	UJ	0.65	UJ	0.66	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Heptachlor epoxide	ug/kg	3.7	NJ	0.53	U	0.52	U	0.51	UJ	0.5	UJ	0.51	UJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methoxychlor	ug/kg			4	U	3.9	U	3.9	UJ	13	J	3.8	UJ	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Toxaphene	ug/kg	79	U	74	U	72	U	71	UJ	70	UJ	70	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Core Location:		TRB-NEWBRUN		TRB-NEWBRUN		TRB-NEWBRUN		TRB-ELSIE		TRB-ELSIE		TRB-SPRING		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A	
Sample Depth:		0-15 cm		15-45 cm		45-58 cm		0-15 cm		15-32 cm		0-21 cm		0-25 cm		25-55 cm		55-74 cm		74-102 cm		102-125 cm		125-150 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
	SVOCs																								
1,1'-Biphenyl	ug/kg	36	U	34	U	33	U	33	U	32	UJ	32	U	17	U	13	U	13	U	12	U	12	U	12	U
1,2,4,5-Tetrachlorobenzene	ug/kg	40	U	37	U	36	U	36	U	35	UJ	35	U	17	U	13	U	13	U	12	U	12	U	12	U
2,2'-Oxybis(1-chloropropane)	ug/kg	49	U	46	U	45	U	44	U	43	UJ	44	U	20	U	15	U	15	U	15	U	15	U	14	U
2,3,4,6-Tetrachlorophenol	ug/kg	56	U	52	U	51	U	51	U	50	UJ	50	U	24	U	18	U	18	U	17	U	17	U	17	U
2,4,5-Trichlorophenol	ug/kg	40	U	37	U	36	U	36	U	35	UJ	35	U	41	U	31	U	31	U	30	U	30	U	29	U
2,4,6-Trichlorophenol	ug/kg	38	U	35	U	35	U	34	U	34	UJ	34	U	17	U	13	U	13	U	12	U	12	U	12	U
2,4-Dichlorophenol	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	19	U	14	U	14	U	14	U	14	U	13	U
2,4-Dimethylphenol	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	34	U	26	U	26	U	25	U	25	U	24	U
2,4-Dinitrophenol	ug/kg	40	UJ	37	UJ	36	UJ	36	UJ	35	UJ	35	U	22	U	17	U	17	U	16	U	16	U	16	U
2,4-Dinitrotoluene	ug/kg	39	U	36	U	35	U	35	U	34	UJ	35	U	17	U	13	U	13	U	12	U	12	U	12	U
2,6-Dinitrotoluene	ug/kg	39	U	36	U	35	U	35	U	34	UJ	34	U	16	U	12	U	12	U	12	U	12	U	12	U
2-Chloronaphthalene	ug/kg	39	U	37	U	36	U	36	U	35	UJ	35	U	17	U	13	U	13	U	12	U	12	U	12	U
2-Chlorophenol	ug/kg	35	U	32	U	32	U	31	U	31	UJ	31	U	17	U	13	U	13	U	12	U	12	U	12	U
2-Methylnaphthalene	ug/kg	25	J	5.8	J	5.7	J	5.6	U	2.8	J	5.5	J	16	U	12	U	12	U	12	U	12	U	11	U
2-Methylphenol	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	20	U	15	U	15	U	15	U	15	U	14	U
2-Nitroaniline	ug/kg	40	U	37	U	36	U	36	U	35	UJ	36	U	17	U	13	U	13	U	12	U	12	U	12	U
2-Nitrophenol	ug/kg	39	U	36	U	35	U	35	U	34	UJ	35	U	16	U	12	U	12	U	12	U	12	U	11	U
3,3'-Dichlorobenzidine	ug/kg			210	U	200	U	200	U	200	UJ	200	UJ	34	U	26	U	26	U	25	U	25	U	24	U
3-Nitroaniline	ug/kg	81	U	75	U	73	U	73	U	71	UJ	72	U	17	U	13	U	13	U	12	U	12	U	12	U
4,6-Dinitro-2-methylphenol	ug/kg	47	U	43	U	42	U	42	U	41	UJ	41	U	24	U	18	U	18	U	17	U	17	U	17	U
4-Bromophenyl-phenylether	ug/kg	38	U	35	U	34	U	34	U	33	UJ	33	U	19	U	14	U	14	U	14	U	14	U	13	U
4-Chloro-3-methylphenol	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	17	U	13	U	13	U	12	U	12	U	12	U
4-Chloroaniline	ug/kg	69	UJ	64	U	62	U	62	U	61	UJ	61	UJ	27	U	20	U	21	U	20	U	20	U	19	U
4-Chlorophenyl-phenylether	ug/kg	36	U	34	U	33	U	33	U	32	UJ	32	U	20	U	15	U	15	U	15	U	15	U	14	U
4-Methylphenol	ug/kg	130	U	120	U	120	U	120	U	120	UJ	120	U	19	U	14	U	14	U	14	U	14	U	13	U
4-Nitroaniline	ug/kg	78	U	72	U	71	U	70	U	69	UJ	69	U	32	U	24	U	24	U	23	U	24	U	23	U
4-Nitrophenol	ug/kg	38	UJ	35	UJ	34	UJ	34	U	33	UJ	34	U	17	U	13	U	13	U	12	U	12	U	12	U
Acenaphthene	ug/kg	190	D	9.4	J	17	J	13	J	3.9	J	49	D	15	U	12	U	12	U	11	U	11	U	11	U
Acenaphthylene	ug/kg	23	J	7.7	J	7.5	J	7.4	U	2.4	J	7.3	J	17	U	13	U	13	U	12	U	12	U	12	U
Acetophenone	ug/kg	50	U	47	U	45	U	45	U	98	J	57	J	20	U	15	U	15	U	15	U	15	U	14	U
Anthracene	ug/kg	510		27	J	40	J	67		22	J	150	D	20	U	15	U	15	U	15	U	15	U	14	U
Atrazine	ug/kg	46	U	43	U	42	U	42	U	41	UJ	41	U	22	U	17	U	17	U	16	U	16	U	16	U
Benzaldehyde	ug/kg	51	U	48	U	46	U	46	U	45	UJ	45	U	20	U	15	U	15	U	15	U	15	U	14	U
Benzo(a)anthracene	ug/kg	2900	J	180	D	240	D	590		250	J	750		250	J	13	U	13	U	12	U	12	U	12	U
Benzo(a)pyrene	ug/kg	2900		160	J	160	D	580		250	J	350	J	280	J	14	U	14	U	14	U	14	U	13	U
Benzo(b)fluoranthene	ug/kg	6000	J	360	J	330	D	910		360	J	1100		480		18	U	18	U	17	U	17	U	17	U
Benzo(g,h,i)perylene	ug/kg	1800	J	130	J	81	D	370		220	J	270	J	190	J	17	U	17	U	16	U	16	U	16	U
Benzo(k)fluoranthene	ug/kg	5200	J	110	J	110	D	290		170	J	350	J	22	U	17	U	17	U	16	U	16	U	16	U
Bis(2-chloroethoxy)methane	ug/kg	39	U	36	U	35	U	35	U	34	UJ	34	U	17	U	13	U	13	U	12	U	12	U	12	U
Bis(2-chloroethyl)ether	ug/kg	48	U	45	U	44	U	44	U	43	UJ	43	U	16	U	12	U	12	U	11	U	12	U	11	U
Bis(2-ethylhexyl)phthalate	ug/kg	220	J	93	U	91	U	96	J	88	UJ	89	U	49	U	37	U	37	U	36	U	36	U	35	U
Butylbenzylphthalate	ug/kg			33	U	32	U	32	U	32	UJ	32	U	22	U	17	U	17	U	16	U	16	U	16	U
Caprolactam	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	27	U	20	U	21	U	20	U	20	U	19	U
Carbazole	ug/kg	360		57	U	55	U	55	U	54	UJ	69	J	19	U	14	U	14	U	14	U	14	U	13	U
Chrysene	ug/kg	3900	J	250	D	270	D	690		330	J	830		280	J	15	U	15	U	15	U	15	U	14	U
Dibenzo(a,h)anthracene	ug/kg	600		33	J	25	J	96		61	J	59	J	58	J	15	U	15	U	15	U	15	U	14	U
Dibenzofuran	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	16	U	12	U	12	U	11	U	11	U	11	U
Diethylphthalate	ug/kg	42	U	39	U	38	U	38	U	37	UJ	37	U	19	U	14	U	14	U	14	U	14	U	13	U
Dimethylphthalate	ug/kg	43	U	40	U	39	U	39	U	38	UJ	38	U	17	U	13	U	13	U	12	U	12	U	12	U
Di-n-butylphthalate	ug/kg	44	U	41	U	40	U	40	U	39	UJ	39	U	22	U	17	U	17	U	16	U	16	U	16	U
Di-n-octylphthalate	ug/kg	47	U	44	U	43	U	43	U	42	UJ	42	U	29	U	22	U	22	U	21	U	21	U	20	U
Fluoranthene	ug/kg	5400	E	310	J	570		1100		360	J	1400		470		13	U	13	U	12	U	12	U	12	U
Fluorene	ug/kg	280	D	20	J	30	J	22	J	7.5	J	69	D	15	U	12	U	12	U	11	U	11	U	11	U
Hexachlorobenzene	ug/kg	43	U	40	U	39	U	38	U	38	UJ	38	U	17	U	13	U	13	U	12	U	12	U	12	U
Hexachlorobutadiene	ug/kg	37	U	34	U	33	U	33	U	32	UJ	32	U	15	U	12	U	12	U	11	U	11	U	11	U
Hexachlorocyclopentadiene	ug/kg	39	UJ	36	UJ	35	UJ	35	UJ	34	UJ	35	UJ	17	U	13	U	13	U	12	U	12	U	12	U
Hexachloroethane	ug/kg	37	U	34	U	33	U	33	U	33	UJ	33	U	15	U	11	U	11	U	11	U	11	U	11	U
Indeno(1,2,3-cd)pyrene	ug/kg	2500	J	190	J	140	D	570		250	J	280	J	200	J	15	U	15	U	15	U	15	U	14	U
Isophorone	ug/kg	42	U	39	U	38	U	38	U	37	UJ	37	U	16	U	12	U	12	U	12	U	12	U	11	U
Naphthalene	ug/kg	4.9	JDB	4.6	J	4.4	U	4.4	U	0.43	UJ	4.4	U	17	U	12	U	12	U	12	U	12	U	12	U
Nitrobenzene	ug/kg	230	U	210	U	200	U	200	U	200	UJ	200	U	19	U	14	U	14	U	14	U	14	U	13	U
N-Nitroso-di-n-propylamine	ug/kg	58	U	54	U	52	U	52	U	51	UJ	51	U	17	U	12	U	12	U	12	U	12	U	12	U
N-Nitrosodiphenylamine	ug/kg	150	U	140	U	130	U	130	U	130	UJ	130	U	19	U	14	U	14	U	14	U	14	U	13	U
Pentachlorophenol	ug/kg	78	UJ	73	UJ	71	UJ	71	U	6.9	UJ	69	U	24	U	18	U	18	U	17	U	17	U	17	U
Phenanthrene	ug/kg	3300		210	D	360		430		140	J	870		200	J	15	U	15	U	15	U	15	U	14	U
Phenol	ug/kg	37	U	35	U	34	U	34	U	33	UJ	33	U	16	U	12	U	12	U	12	U	12	U	11	U
Pyrene	ug/kg	7800	J	340	J	330	J	1000		430	J	1300	J	490		14	U	14	U	14	U	14	U	13	U

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	TRB-NEWBRUN		TRB-NEWBRUN		TRB-NEWBRUN		TRB-ELSIE		TRB-ELSIE		TRB-SPRING		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A		BB-RM8.1A	
	Sample Depth:	0-15 cm		15-45 cm		45-58 cm		0-15 cm		15-32 cm		0-21 cm		0-25 cm		25-55 cm		55-74 cm		74-102 cm		102-125 cm		125-150 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
	VOCs																								
1,1,1-Trichloroethane	ug/kg	0.57	U	0.43	U	0.55	U	0.43	U	0.43	U	0.49	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2,2-Tetrachloroethane	ug/kg	0.59	U	0.44	U	0.56	U	0.44	U	0.44	U	0.51	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/kg	1.3	U	0.98	U	1.2	U	0.97	U	0.97	U	1.1	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2-Trichloroethane	ug/kg	0.48	U	0.37	U	0.46	U	0.36	U	0.36	U	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1-Dichloroethane	ug/kg	0.66	U	0.5	U	0.63	U	0.5	U	0.5	U	0.57	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1-Dichloroethene	ug/kg	1.5	U	1.1	U	1.4	U	1.1	U	1.1	U	1.3	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2,3-Trichlorobenzene	ug/kg	0.62	U	0.47	U	0.59	U	0.46	U	0.46	U	0.53	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2,4-Trichlorobenzene	ug/kg	0.78	U	0.59	U	0.75	U	0.58	U	0.58	U	0.67	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dibromo-3-chloropropane	ug/kg	1.4	U	1.1	U	1.4	U	1.1	U	1.1	U	1.2	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dibromoethane	ug/kg	0.41	U	0.31	U	0.39	U	0.31	U	0.31	U	0.36	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichlorobenzene	ug/kg	0.48	U	0.37	U	0.46	U	0.36	U	0.36	U	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichloroethane	ug/kg	0.51	U	0.39	U	0.49	U	0.39	U	0.39	U	0.44	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichloropropane	ug/kg	0.97	U	0.73	U	0.93	U	0.73	U	0.73	U	0.84	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,3-Dichlorobenzene	ug/kg	0.5	U	0.38	U	0.48	U	0.37	U	0.37	U	0.43	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,4-Dichlorobenzene	ug/kg	0.6	U	0.46	U	0.58	U	0.45	U	0.45	U	0.52	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
2-Butanone	ug/kg	40		1.8	U	2.3	U	1.8	U	1.8	U	2.1	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
2-Hexanone	ug/kg	1.7	U	1.3	U	1.6	U	1.2	U	1.2	U	1.4	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4-Methyl-2-pentanone	ug/kg	1.8	U	1.4	U	1.7	U	1.4	U	1.4	U	1.6	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Acetone	ug/kg	86		3.3	U	4.2	U	3.3	U	3.3	U	3.8	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Benzene	ug/kg	0.82	U	0.62	U	0.79	U	0.62	U	0.62	U	0.71	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromochloromethane	ug/kg	0.71	U	0.53	U	0.68	U	0.53	U	0.53	U	0.61	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromodichloromethane	ug/kg	0.48	U	0.37	U	0.46	U	0.36	U	0.36	U	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromoform	ug/kg	0.5	U	0.38	U	0.48	U	0.37	U	0.37	U	0.43	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromomethane	ug/kg	1.9	U	1.4	U	1.8	U	1.4	U	1.4	U	1.6	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Carbon Disulfide	ug/kg	1.4	J	0.44	U	0.56	U	0.44	U	0.44	U	0.59	J	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Carbon tetrachloride	ug/kg	0.59	U	0.44	U	0.56	U	0.44	U	0.44	U	0.51	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chlorobenzene	ug/kg	0.54	U	0.41	U	0.52	U	0.41	U	0.41	U	0.47	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloroethane	ug/kg	1.3	U	0.96	U	1.2	U	0.95	U	0.95	U	1.1	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloroform	ug/kg	0.59	U	0.44	U	0.56	U	0.44	U	0.44	U	0.51	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloromethane	ug/kg	1.1	U	0.83	U	1.1	U	0.83	U	0.83	U	0.95	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
cis-1,2-Dichloroethene	ug/kg	0.73	U	0.56	U	0.7	U	0.55	U	0.55	U	39		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
cis-1,3-Dichloropropene	ug/kg	0.68	U	0.51	U	0.65	U	0.51	U	0.51	U	0.58	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Cyclohexane	ug/kg	0.53	U	0.4	U	0.51	U	0.4	U	0.4	U	0.46	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dibromochloromethane	ug/kg	0.46	U	0.34	U	0.44	U	0.34	U	0.34	U	0.39	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dichlorodifluoromethane	ug/kg	0.65	U	0.49	U	0.62	U	0.48	U	0.48	U	0.56	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Ethylbenzene	ug/kg	0.6	U	0.46	U	0.58	U	0.45	U	0.45	U	0.52	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Isopropylbenzene	ug/kg	0.53	U	0.4	U	0.51	U	0.4	U	0.4	U	0.46	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
m,p-Xylene	ug/kg	0.54	U	0.41	U	0.52	U	0.41	U	0.41	U	0.47	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methyl acetate	ug/kg	1.6	U	1.2	U	1.5	U	1.2	U	1.2	U	1.4	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methyl tert-butyl ether	ug/kg	0.37	U	0.28	U	0.35	U	0.28	U	0.28	U	0.32	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methylcyclohexane	ug/kg	0.59	U	0.44	U	0.56	U	0.44	U	0.44	U	0.51	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methylene chloride	ug/kg	0.93	U	0.7	U	0.89	U	0.69	U	0.69	U	0.8	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
o-Xylene	ug/kg	0.48	U	0.37	U	0.46	U	0.36	U	0.36	U	0.42	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Styrene	ug/kg	0.46	U	0.34	U	0.44	U	0.34	U	0.34	U	0.39	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Tetrachloroethene	ug/kg	0.62	U	0.47	U	0.59	U	0.46	U	0.46	U	0.53	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Toluene	ug/kg	0.62	U	0.47	U	0.59	U	0.46	U	0.46	U	0.53	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
trans-1,2-Dichloroethene	ug/kg	0.69	U	0.52	U	0.66	U	0.52	U	0.52	U	0.6	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
trans-1,3-Dichloropropene	ug/kg	0.94	U	0.71	U	0.9	U	0.71	U	0.7	U	0.81	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Trichloroethene	ug/kg	0.57	U	0.43	U	0.55	U	1.2	J	0.43	U	0.49	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Trichlorofluoromethane	ug/kg	0.62	U	0.47	U	0.59	U	0.46	U	0.46	U	0.53	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Vinyl chloride	ug/kg	0.94	U	0.71	U	0.9	U	0.71	U	0.7	U	0.81	U	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
	TOC and Percent Moisture																								
Total Organic Carbon	mg/kg	8330		7430		133	J	1550		1810		2890		36900		1490		141		122		725		168	
Percent Moisture	%	22.3		18.8		17.6		18.4		15.9		13.7		45.4		20.3		19.6		18.2		16.3		19.7	

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-RM8.1A		BB-RM8.1A		BB-RM8.1B		BB-RM8.1B		BB-RM8.1B		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3B		BB-RM8.3B		BB-RM8.3B	
	Sample Depth:	150-170 cm		170-193 cm		0-20 cm		20-48 cm		48-77 cm		0-30 cm		30-44 cm		44-64 cm		64-80 cm		0-23 cm		23-50 cm		50-73 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Metals and Cyanide																									
Aluminum	mg/kg	5830		8300		9350	J	18000	J	7050		4820		7640		8440		6430		4570		9090		9590	
Antimony	mg/kg	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ	0.038	UJ
Arsenic	mg/kg	3.3	D	5	D	3.4	J	8.4	J	1.9	D	0.75	D	1.8	D	1.8	D	2.6	D	0.44	J	2.4	D	0.65	D
Barium	mg/kg	18.5	D	25.8	D	142	J	292	J	22.6	D	39.9	D	59.9	D	126	D	95.8	D	33.4	D	87	D	49.3	D
Beryllium	mg/kg	0.025	U	0.49	D	0.025	UJ	1.1	J	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U
Cadmium	mg/kg	0.063	J	0.15	J	11.7	J	44	J	0.28	J	2.1	D	7.2	D	13.8	D	11.9	D	1.9	D	9.9	D	1.7	D
Calcium	mg/kg	1380	J	1740	J	4070	J	5320	J	1370	J	1220	J	2780	J	2420	J	1930	J	962	J	2220	J	1780	J
Chromium	mg/kg	8.5	J	11.9	J	20.5	J	66.5	J	11.1	J	8.3	J	15.3	J	17	J	15	J	9.3	J	18.2	J	12.9	J
Cobalt	mg/kg	5.3	D	6.9	D	8.4	J	16.2	J	6.2	D	3.8	D	6.7	D	5.6	D	7	D	4.3	D	6.2	D	5.9	D
Copper	mg/kg	6.8	D	9	D	49.6	J	151	J	7.9	D	8.4	D	25.6	D	23.8	D	16.2	D	9	D	33.7	D	14.3	D
Cyanide	mg/kg	0.062	U	0.062	U	0.062	UJ	0.062	UJ	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U
Iron	mg/kg	16000		22100	D	18000	J	29100	J	14400		8780		15500		9040		8910		8530		10900		12500	
Lead	mg/kg	4.3	D	6.9	D	92.4	J	437	J	7	D	22.1	D	68.6	D	66.5	D	35	D	19.3	D	98.6	D	17.1	D
Magnesium	mg/kg	3510		5310		3470	J	5800	J	3650		2100		2900		2600		2560		2210		2890		3830	
Manganese	mg/kg	78.1	D	94.9	D	150	J	127	J	75.1	D	74.9	D	66.7	D	57.3	D	66.5	D	51	D	58.6	D	72.9	D
Mercury	mg/kg	0.0022	U	0.0022	U	0.0022	UJ	0.58	J	0.12		0.0022	U	0.0022	U	0.0022	U	0.0022	U	0.0022	U	0.0022	U	0.0022	U
Nickel	mg/kg	11.9	D	16.9	D	26.4	J	82.5	J	13.9	D	8.7	D	18.4	D	27.6	D	30.7	D	9.6	D	24.6	D	14.8	D
Potassium	mg/kg	1180	J	2010	J	1390	J	2240	J	1530	J	922	J	1290	J	1090	J	1090	J	941	J	1280	J	1700	J
Selenium	mg/kg	0.15	U	0.15	U	0.15	UJ	0.15	UJ	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
Silver	mg/kg	0.015	U	0.015	U	4.4	J	20.8	J	0.015	U	0.015	U	1.3	D	5.5	D	2.1	D	0.015	U	3.9	D	1	D
Sodium	mg/kg	7.7	U	7.7	U	7.7	UJ	7.7	UJ	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U	7.7	U
Thallium	mg/kg	0.006	U	0.006	U	0.006	UJ	0.006	UJ	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U
Vanadium	mg/kg	14.3	J	19.3	J	22.4	J	42	J	13.8	J	7.3	J	12.1	J	18.2	J	15.2	J	9.1	J	16.2	J	15.2	J
Zinc	mg/kg	28.6	J	34.8	J	248	J	526	J	34.2	J	60.1	J	135	J	72.5	J	57.3	J	62.5	J	133	J	39.8	J
PCB Aroclors																									
Aroclor-1016	ug/kg	18	U	18	U	30	U	31	U	19	U	19	U	22	U	22	U	19	U	19	U	23	U	20	U
Aroclor-1221	ug/kg	28	U	27	U	47	U	48	U	30	U	29	U	34	U	34	U	30	U	29	U	35	U	30	U
Aroclor-1232	ug/kg	20	U	19	U	32	U	34	U	21	U	20	U	24	U	24	U	21	U	20	U	24	U	21	U
Aroclor-1242	ug/kg	18	U	18	U	30	U	31	U	19	U	19	U	22	U	22	U	19	U	19	U	23	U	20	U
Aroclor-1248	ug/kg	10	U	10	U	17	U	18	U	11	U	11	U	13	U	13	U	11	U	11	U	13	U	11	U
Aroclor-1254	ug/kg	10	U	9.9	U	100	JN	390	J	11	U	11	U	59		91		11	U	10	U	150	J	11	U
Aroclor-1260	ug/kg	5.5	U	5.4	U	9.1	U	300		5.8	U	5.7	U	6.7	U	30	J	5.8	U	5.7	U	110		5.9	U
Aroclor-1262	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
Aroclor-1268	ug/kg	6.5	U	6.3	U	11	U	11	U	6.8	U	6.8	U	7.9	U	7.8	U	6.8	U	6.7	U	8	U	6.9	U
Pesticides																									
4,4'-DDD	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4,4'-DDE	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4,4'-DDT	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Aldrin	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
alpha-BHC	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
alpha-Chlordane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
beta-BHC	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
delta-BHC	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dieldrin	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan I	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan II	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endosulfan sulfate	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin aldehyde	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Endrin ketone	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
gamma-BHC (Lindane)	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
gamma-Chlordane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Heptachlor	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Heptachlor epoxide	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methoxychlor	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Toxaphene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-RM8.1A		BB-RM8.1A		BB-RM8.1B		BB-RM8.1B		BB-RM8.1B		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3B		BB-RM8.3B		BB-RM8.3B	
	Sample Depth:	150-170 cm		170-193 cm		0-20 cm		20-48 cm		48-77 cm		0-30 cm		30-44 cm		44-64 cm		64-80 cm		0-23 cm		23-50 cm		50-73 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
	SVOCs																								
1,1'-Biphenyl	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	14	U	13	U	12	U	15	U	13	U
1,2,4,5-Tetrachlorobenzene	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	12	U	15	U	13	U
2,2'-Oxybis(1-chloropropane)	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
2,3,4,6-Tetrachlorophenol	ug/kg	17	U	17	U	28	U	29	U	18	U	18	U	21	U	21	U	18	U	18	U	21	U	18	U
2,4,5-Trichlorophenol	ug/kg	29	U	29	U	49	U	50	U	31	U	31	U	36	U	35	U	31	U	30	U	36	U	31	U
2,4,6-Trichlorophenol	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
2,4-Dichlorophenol	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
2,4-Dimethylphenol	ug/kg	24	U	24	U	40	U	42	U	26	U	26	U	30	U	30	U	26	U	25	U	30	U	26	U
2,4-Dinitrophenol	ug/kg	16	U	15	U	26	UJ	27	UJ	17	UJ	17	UJ	19	UJ	19	UJ	17	UJ	16	UJ	20	UJ	17	UJ
2,4-Dinitrotoluene	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
2,6-Dinitrotoluene	ug/kg	12	U	11	U	19	U	20	U	12	U	12	U	14	U	14	U	12	U	12	U	15	U	13	U
2-Chloronaphthalene	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	12	U	15	U	13	U
2-Chlorophenol	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
2-Methylnaphthalene	ug/kg	11	U	11	U	19	U	20	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
2-Methylphenol	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
2-Nitroaniline	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
2-Nitrophenol	ug/kg	12	U	11	U	19	U	20	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
3,3'-Dichlorobenzidine	ug/kg	24	U	24	U	40	U	42	U	26	U	26	U	30	U	30	U	26	U	25	U	30	U	26	U
3-Nitroaniline	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
4,6-Dinitro-2-methylphenol	ug/kg	17	U	17	U	28	U	29	U	18	U	18	U	21	U	21	U	18	U	18	U	21	U	18	U
4-Bromophenyl-phenylether	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
4-Chloro-3-methylphenol	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
4-Chloroaniline	ug/kg	19	U	19	U	32	U	34	U	21	U	20	U	24	U	24	U	21	U	20	U	24	U	21	U
4-Chlorophenyl-phenylether	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
4-Methylphenol	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
4-Nitroaniline	ug/kg	23	U	23	U	38	U	40	U	25	U	24	U	28	U	28	U	24	U	24	U	29	U	25	U
4-Nitrophenol	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
Acenaphthene	ug/kg	11	U	11	U	18	U	19	U	12	U	12	U	14	U	13	U	12	U	11	U	14	U	12	U
Acenaphthylene	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
Acetophenone	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
Anthracene	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
Atrazine	ug/kg	16	U	15	U	26	U	27	U	17	U	17	U	19	U	19	U	17	U	16	U	20	U	17	U
Benzaldehyde	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
Benzo(a)anthracene	ug/kg	12	U	12	U	540		820		13	U	13	U	210	J	170	J	13	U	13	U	15	U	13	U
Benzo(a)pyrene	ug/kg	13	U	13	U	630		930		14	U	14	U	200	J	170	J	14	U	14	U	130	J	14	U
Benzo(b)fluoranthene	ug/kg	17	U	17	U	1100		1500		18	U	190	J	390		280		170	J	18	U	210	J	110	J
Benzo(g,h,i)perylene	ug/kg	16	U	15	U	430		510		17	U	17	U	120	J	19	U	17	U	16	U	20	U	17	U
Benzo(k)fluoranthene	ug/kg	16	U	15	U	420		650		17	U	17	U	19	U	19	U	17	U	16	U	20	U	17	U
Bis(2-chloroethoxy)methane	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	14	U	13	U	12	U	15	U	13	U
Bis(2-chloroethyl)ether	ug/kg	11	U	11	U	19	U	19	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
Bis(2-ethylhexyl)phthalate	ug/kg	35	U	35	U	720		4700	E	37	U	170	J	430		1400		330		36	U	400		38	U
Butylbenzylphthalate	ug/kg	16	U	15	U	26	U	27	U	17	U	17	U	19	U	19	U	17	U	16	U	20	U	17	U
Caprolactam	ug/kg	19	U	19	U	32	U	34	U	21	U	20	U	24	U	24	U	21	U	20	U	24	U	21	U
Carbazole	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
Chrysene	ug/kg	15	U	14	U	700		850		15	U	120	J	240	J	170	J	15	U	15	U	130	J	16	U
Dibenzo(a,h)anthracene	ug/kg	15	U	14	U	24	U	25	U	15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
Dibenzofuran	ug/kg	11	U	11	U	19	U	19	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
Diethylphthalate	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
Dimethylphthalate	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
Di-n-butylphthalate	ug/kg	16	U	15	U	26	U	27	U	17	U	17	U	19	U	19	U	17	U	16	U	20	U	17	U
Di-n-octylphthalate	ug/kg	21	U	20	U	34	UJ	36	UJ	22	UJ	22	UJ	25	UJ	25	UJ	22	UJ	21	UJ	26	UJ	22	UJ
Fluoranthene	ug/kg	12	U	12	U	1100		1400		13	U	170	J	410		320		170	J	13	U	210	J	13	U
Fluorene	ug/kg	11	U	11	U	18	U	19	U	12	U	11	U	13	U	13	U	12	U	11	U	14	U	12	U
Hexachlorobenzene	ug/kg	12	U	12	U	20	U	21	U	13	U	13	U	15	U	15	U	13	U	13	U	15	U	13	U
Hexachlorobutadiene	ug/kg	11	U	11	U	18	U	19	U	12	U	12	U	14	U	13	U	12	U	11	U	14	U	12	U
Hexachlorocyclopentadiene	ug/kg	12	UJ	12	UJ	20	UJ	21	UJ	13	UJ	13	UJ	15	UJ	15	UJ	13	UJ	13	UJ	15	UJ	13	UJ
Hexachloroethane	ug/kg	11	U	10	U	18	U	18	U	11	U	11	U	13	U	13	U	11	U	11	U	13	U	11	U
Indeno(1,2,3-cd)pyrene	ug/kg	15	U	14	U	460		550		15	U	15	U	140	J	18	U	15	U	15	U	18	U	16	U
Isophorone	ug/kg	11	U	11	U	19	U	20	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
Naphthalene	ug/kg	12	U	12	U	20	U	20	U	13	U	12	U	14	U	14	U	12	U	12	U	15	U	13	U
Nitrobenzene	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
N-Nitroso-di-n-propylamine	ug/kg	12	U	12	U	20	U	20	U	13	U	12	U	14	U	14	U	12	U	12	U	15	U	13	U
N-Nitrosodiphenylamine	ug/kg	13	U	13	U	22	U	23	U	14	U	14	U	16	U	16	U	14	U	14	U	17	U	14	U
Pentachlorophenol	ug/kg	17	U	17	U	28	U	29	U	18	U	18	U	21	U	21	U	18	U	18	U	21	U	18	U
Phenanthrene	ug/kg	15	U	14	U	400		440		15	U	15	U	18	U	18	U	15	U	15	U	18	U	16	U
Phenol	ug/kg	12	U	11	U	19	U	20	U	12	U	12	U	14	U	14	U	12	U	12	U	14	U	12	U
Pyrene	ug/kg	13	U	13	U	1200		2600		14	U	200	J	500		470		250		14	U	310		130	J

Table B-4
TABULATION OF SEDIMENT CONCENTRATIONS AT UNNAMED TRIBUTARIES AND TALMADGE ROAD BRIDGE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

	Core Location:	BB-RM8.1A		BB-RM8.1A		BB-RM8.1B		BB-RM8.1B		BB-RM8.1B		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3A		BB-RM8.3B		BB-RM8.3B		BB-RM8.3B	
	Sample Depth:	150-170 cm		170-193 cm		0-20 cm		20-48 cm		48-77 cm		0-30 cm		30-44 cm		44-64 cm		64-80 cm		0-23 cm		23-50 cm		50-73 cm	
Compound	Units	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
	VOCs																								
1,1,1-Trichloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2,2-Tetrachloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1,2-Trichloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1-Dichloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,1-Dichloroethene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2,3-Trichlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2,4-Trichlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dibromo-3-chloropropane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dibromoethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,2-Dichloropropane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,3-Dichlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
1,4-Dichlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
2-Butanone	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
2-Hexanone	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
4-Methyl-2-pentanone	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Acetone	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Benzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromochloromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromodichloromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromoform	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Bromomethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Carbon Disulfide	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Carbon tetrachloride	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chlorobenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloroethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloroform	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Chloromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
cis-1,2-Dichloroethene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
cis-1,3-Dichloropropene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Cyclohexane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dibromochloromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Dichlorodifluoromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Ethylbenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Isopropylbenzene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
m,p-Xylene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methyl acetate	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methyl tert-butyl ether	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methylcyclohexane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Methylene chloride	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
o-Xylene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Styrene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Tetrachloroethene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Toluene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
trans-1,2-Dichloroethene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
trans-1,3-Dichloropropene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Trichloroethene	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Trichlorofluoromethane	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
Vinyl chloride	ug/kg	Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled		Not Sampled	
	TOC and Percent Moisture																								
Total Organic Carbon	mg/kg	158		700		46600	M	54200	M	727		4110		17800		24300		9850		1240		11100		1680	
Percent Moisture	%	17.5		15.3		56.7		53.5		21		18.2		34.1		30.9		26.8		19.7		32.3		21	

Notes:

Non-detected values (i.e., "U" or "UJ" qualified) are presented as the Method Detection Limit.
Field duplicate samples are not presented.
Pesticides and VOCs were not analyzed for samples collected at River Mile 8.1 and 8.3.
Result values qualified with "U" indicate the compound was analyzed for but not detected.
Result values qualified with "J" indicate the result is estimated.
Result values qualified with "N" indicate presumed evidence of a TIC (Tentaviely Identified Compound).
Result values qualified with "E" indicate result values exceeding the highest standard used during the initial calibration of the analytical instrument for that specific compound.
Result values qualified with "B" indicate probable blank contamination.
Result values qualified with "D" indicate reanalysis of sample or extract with a dilution factor greater than 1.0.
Result values qualified with "M" indicate percent moisture of sample was greater than 50%.

Table B-5
TABULATION OF VOC PASSIVE DIFFUSIVE BAG ANALYTICAL RESULTS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

		PW01		PW02		PW03		PW04		PW05	
Compound	Units	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
1,1,1-Trichloroethane	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 UE	0.8 U	0.8 UE	0.8 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,1-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	3 J	2 J	1 U	1 U
1,1-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,2,3-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane	ug/L	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U
Benzene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	1 UE	1 UE	1 UE	1 UE	1 UE	1 UE	1 U	1 UE	1 U	1 UE
Carbon Disulfide	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 UE	1 U	1 UE	1 U
Chlorobenzene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloroethane	ug/L	1 UE	1 UE	1 UE	1 UE	1 UE	1 UE	1 U	1 UE	1 U	1 UE
Chloroform	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	490	410	120	8
cis-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cyclohexane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Dibromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	ug/L	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE
Ethylbenzene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Freon 113	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Isopropylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methyl Acetate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylcyclohexane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
m-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
o-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Styrene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Toluene	ug/L	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
trans-1,2-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	4 J	2 J	0.8 U	0.8 U
trans-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichlorofluoromethane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 UE	2 U	2 UE	2 U
Vinyl Chloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	380	290	64	3 J

Table B-5
TABULATION OF VOC PASSIVE DIFFUSIVE BAG ANALYTICAL RESULTS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Compound	Units	PW06		PW07		PW08		PW88 (duplicate of PW08)		PW09	
		Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
1,1,1-Trichloroethane	ug/L	0.8 UE	0.8 U	0.8 UE	0.8 U	0.8 UE	0.8 U	0.8 UE	0.8 U	0.8 U	0.8 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,1-Dichloroethane	ug/L	1 J	1 U	1 J	1 U	1 U	1 U	1 U	1 U	2 J	2 J
1,1-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	2 J	0.8 U	2 J	0.8 U	4 J	0.8 U
1,2,3-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	3 J	4 J	1 J	3 J	1 U	1 U	1 U	1 U	1 U	3 J
1,4-Dioxane	ug/L	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U
Benzene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 J	0.5 U	0.5 J	0.5 U	0.5 U
Bromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	1 U	1 UE	1 U	1 UE	1 U	1 UE	1 U	1 UE	1 UE	1 UE
Carbon Disulfide	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	ug/L	1 UE	1 U	1 UE	1 U	1 UE	1 U	1 UE	1 U	1 U	1 U
Chlorobenzene	ug/L	1 J	0.9 J	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloroethane	ug/L	1 U	1 UE	1 U	1 UE	1 U	1 UE	1 U	1 UE	1 UE	1 UE
Chloroform	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	17	39	3 J	6	1700 E	86 E	1400 E	750 E	1300	290
cis-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cyclohexane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Dibromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	ug/L	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE
Ethylbenzene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Freon 113	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Isopropylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methyl Acetate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylcyclohexane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
m-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
o-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Styrene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Toluene	ug/L	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
trans-1,2-Dichloroethene	ug/L	0.9 J	0.8 U	0.8 U	0.8 U	5 J	1 J	4 J	4 J	8	3 J
trans-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichlorofluoromethane	ug/L	2 UE	2 U	2 UE	2 U	2 UE	2 U	2 UE	2 U	2 U	2 U
Vinyl Chloride	ug/L	110	42	10	17	680	720	510	1700	350	440

Table B-5
TABULATION OF VOC PASSIVE DIFFUSIVE BAG ANALYTICAL RESULTS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

		PW10		PW13		PW14		PW16		PW17	
Compound	**Units**	**Event 1**	**Event 2**	**Event 1**	**Event 2**	**Event 1**	**Event 2**	**Event 1**	**Event 2**	**Event 1**	**Event 2**
1,1,1-Trichloroethane	ug/L	2 U	0.8 U	0.8 UE	0.8 U	4 UE	0.8 U	0.8 UE	0.8 U	0.8 UE	0.8 U
1,1,2,2-Tetrachloroethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	2 U	1 J	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,1-Dichloroethane	ug/L	3 J	3 J	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	ug/L	12 J	11	8	4 J	10 J	5 J	0.8 U	0.8 U	0.8 U	0.8 U
1,2,3-Trichlorobenzene	ug/L	3 U	1 J	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	3 U	4 J	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	ug/L	5 U	2 U	2 U	2 U	10 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	3 U	3 J	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane	ug/L	180 U	70 U	70 U	70 U	350 U	70 U	70 U	70 U	70 U	70 U
Benzene	ug/L	1 U	0.5 U	2 J	1 J	5 J	2 J	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	3 UE	1 UE	1 U	1 UE	5 U	1 UE	1 U	1 UE	1 U	1 UE
Carbon Disulfide	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	ug/L	3 U	1 U	1 UE	1 U	5 UE	1 U	1 UE	1 U	1 UE	1 U
Chlorobenzene	ug/L	2 U	1 J	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloroethane	ug/L	3 UE	1 UE	1 U	1 UE	5 U	1 UE	1 U	1 UE	1 U	1 UE
Chloroform	ug/L	2 U	0.8 U	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloromethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	2800	2100	2800	2100	4000	2400	15	11	14	5
cis-1,3-Dichloropropene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Cyclohexane	ug/L	5 U	2 U	2 U	2 U	10 U	2 U	2 U	2 U	2 U	2 U
Dibromochloromethane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	ug/L	5 UE	2 UE	2 UE	2 UE	10 UE	2 UE	2 UE	2 UE	2 UE	2 UE
Ethylbenzene	ug/L	2 U	0.8 U	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Freon 113	ug/L	5 U	2 U	2 U	2 U	10 U	2 U	2 U	2 U	2 U	2 U
Isopropylbenzene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Methyl Acetate	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Methylcyclohexane	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	ug/L	5 U	2 U	2 U	2 U	10 U	2 U	2 U	2 U	2 U	2 U
m-Xylene	ug/L	2 U	0.8 U	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
o-Xylene	ug/L	2 U	0.8 U	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Styrene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	2 U	0.8 U	0.8 U	0.8 U	4 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Toluene	ug/L	2 U	0.7 U	0.7 U	0.7 U	4 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
trans-1,2-Dichloroethene	ug/L	8 J	9	19	13	18 J	16	0.8 U	0.8 U	0.8 U	0.8 U
trans-1,3-Dichloropropene	ug/L	3 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	3 U	1 U	1 J	1 U	12 J	1 U	7	5 J	5 J	1 J
Trichlorofluoromethane	ug/L	5 U	2 U	2 UE	2 U	10 UE	2 U	2 UE	2 U	2 UE	2 U
Vinyl Chloride	ug/L	260	280	72	120	25	190	1 J	1 U	1 J	1 U

Table B-5
TABULATION OF VOC PASSIVE DIFFUSIVE BAG ANALYTICAL RESULTS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

		PW18		PW19		PW20	
Compound	**Units**	**Event 1**	**Event 2**	**Event 1**	**Event 2**	**Event 1**	**Event 2**
1,1,1-Trichloroethane	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,1,2,2-Tetrachloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,1-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
1,2,3-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromo-3-chloropropane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane	ug/L	70 U	70 U	70 U	70 U	70 U	70 U
Benzene	ug/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	ug/L	1 UE	1 UE	1 UE	1 UE	1 UE	1 UE
Carbon Disulfide	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloroethane	ug/L	1 UE	1 UE	1 UE	1 UE	1 UE	1 UE
Chloroform	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Chloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/L	5 J	7	2 J	5 J	8	0.8 U
cis-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Cyclohexane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
Dibromochloromethane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	ug/L	2 UE	2 UE	2 UE	2 UE	2 UE	2 UE
Ethylbenzene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Freon 113	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
Isopropylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Methyl Acetate	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Methylcyclohexane	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
m-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
o-Xylene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Styrene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Toluene	ug/L	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
trans-1,2-Dichloroethene	ug/L	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
trans-1,3-Dichloropropene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	ug/L	1 U	3 J	1 U	1 U	3 J	1 U
Trichlorofluoromethane	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	ug/L	3 J	1 U	1 U	5 J	1 U	1 U

Notes:

Porewater VOC concentrations measured using polyethylene passive diffusion bags deployed for two sampling events. First event: Deployed July 11-17, 2012, Retrieved July 24-25, 2012. Second event: Deployed July 24-25, 2012, Retrieved August 21-24, 2012.
Non-detected values (*i.e.* , "U" or "UE" qualified) are presented as the Method Detection Limit.
Result values qualified with "U" indicate the compound was analyzed for but not detected.
Result values qualified with "E" indicate result values exceeding the highest standard used during the initial calibration of the analytical instrument for that specific compound.
Result values qualified with "J" indicate the result is estimated.

Appendix C:

Cornell-Dubilier Electronics, Inc. Superfund Site – Capacitor Disposal Area Summary

MALCOLM PIRNIE

Technical Memo

Date: April 03, 2007

To: USACE-KCD

From: Malcolm Pirnie

Re: Cornell-Dubilier Electronics, Inc. Superfund Site – Capacitor Disposal Area Summary

1. Background

The purpose of this memo is to summarize the findings related to the "Capacitor Disposal Area" as discussed in the Remedial Investigation (RI) performed by Foster Wheeler Corporation, and Feasibility Study (FS) performed by Tetra Tech FW, Inc. Malcolm Pirnie will be assisting USACE-KCD in development of an interim remedial design for the excavation and off-site disposal of hazardous materials within the Capacitor Disposal Area. An understanding of the estimated limits and types of contamination as determined through the previous investigations will be required to perform the design.

2. Remedial Investigation Summary

According to the Remedial Investigation, the central undeveloped portion of the facility is primarily an open field (See attached Figure 4-10 of RI), with some wooded areas to the northeast and south, and a deteriorated, partially paved area in the middle. Historical activities on this property may have included the filling and disposal of equipment (i.e., capacitors and other electronic hardware), occasional spills/releases of transformer oils containing PCBs, and burning of waste oils and equipment contaminated with PCBs, as well as the potential burning of spent solvents and oils on site.

A geophysical survey of this portion of the property indicated the presence of anomalies, especially from the northeastern portion of the former truck driving school (fenced area) to the embankment leading to the Bound Brook. Test pits were excavated within the anomalous areas. Test Pit Records from TP-6, TP-8, TP-9, and TP-10 found evidence of various electrical components including electrical boxes thought to be capacitors, white and blue crystalline powder, and other miscellaneous electrical components. Subsurface samples also indicated that significant elevated Total PCB concentrations were present at these test pits. See attached RI Figure 4-3 for test pit locations and areas of geophysical survey anomalies. RI Test Pit Record logs for TP-6, TP-8, TP-9, and TP-10 are also attached.

3. Feasibility Study Summary

Based on the test pit and geophysical survey findings of the RI, three sub-areas of the Capacitor Disposal Area were further defined in the FS. Attached Figure 4-5 of the FS shows the overall Capacitor Disposal Area and defines the limits of these three sub-areas.

1) **Capacitor Area 1-** Sub-Area 1 is located at the eastern corner of the central undeveloped portion of the site. Following the discovery of capacitors during the excavation of test pits TP-08 and TP-09, further inspection was performed by EPA and Tetra Tech personnel during the Remedial Investigation revealing that boxes appeared corroded and/or partially burned at these test pits. Other indications of disposal in these areas included the presence of white and blue crystalline powder, “mica-like” and “battery-shaped” pieces of material, 2-inch long white cylindrical objects, 5-inch diameter cardboard disks, and ceramic electrical components in TP-8 and TP-09. In addition, extremely elevated Total PCB concentrations are present in the subsurface soils at these test pits at less than 6 feet bgs (8,300 mg/kg in TP-08 and 29,000 mg/kg in TP-09). Based on these findings, this capacitor area was estimated at approximately 31,600 square feet in area and approximately 4 feet in depth, corresponding to total volume of approximately 126,400 cubic feet or 4,680 cubic yards.

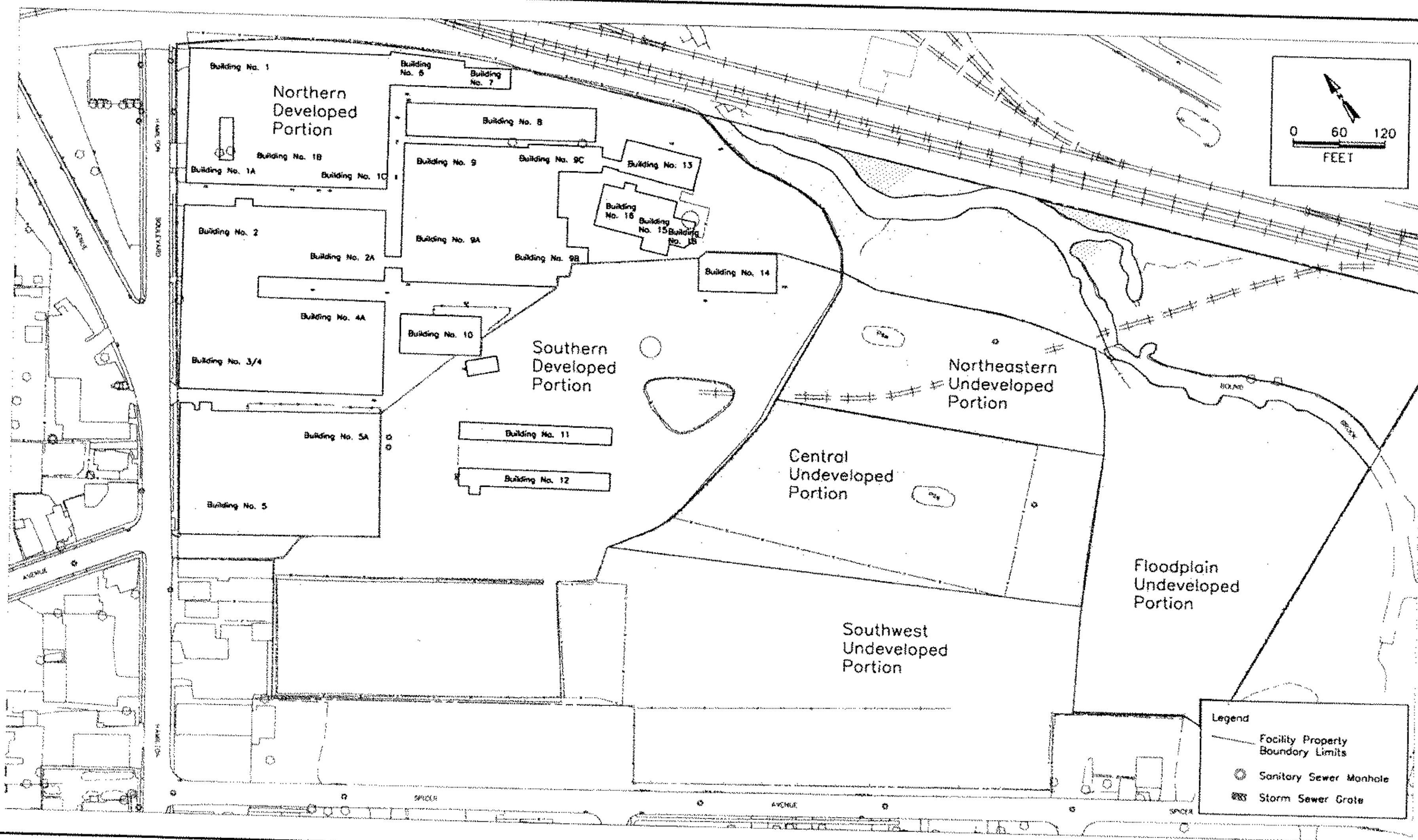
2) **Capacitor Area 2 –** Sub-Area 2 is located at the western corner of the central undeveloped portion. Capacitors were unearthed during the excavation of test pit TP-06. The Total PCBs in the TP-06 subsurface soil sample (less than 8 feet bgs) reached 6,600 mg/kg. Test pit TP-10 at its eastern boundary also contained white and blue crystalline power in the soil. This capacitor area was estimated at approximately 4,760 square feet in area and 5 feet in depth, corresponding to total volume of approximately 23,800 cubic feet or 880 cubic yards.

3) **Capacitor Area 3 –** Sub-Area 3 is located in the middle of the central undeveloped portion next to the Capacitor Area 1. This area was defined based only on geophysical survey anomalies and may potentially contain buried capacitor debris. The area was estimated at approximately 14,780 square feet in area and an assumed 4 feet in depth, corresponding to total volume of approximate 55,120 cubic feet or 2,040 cubic yards.

Remedial action objectives were identified and technologies were screened during the FS. Under alternatives S-2 through S-5, excavation and off-site disposal of the approximately 7,500 cubic yards within the Capacitor Disposal Areas were recommended.

4. Selected Remedial Actions for Capacitor Areas under Remedial of Reaction

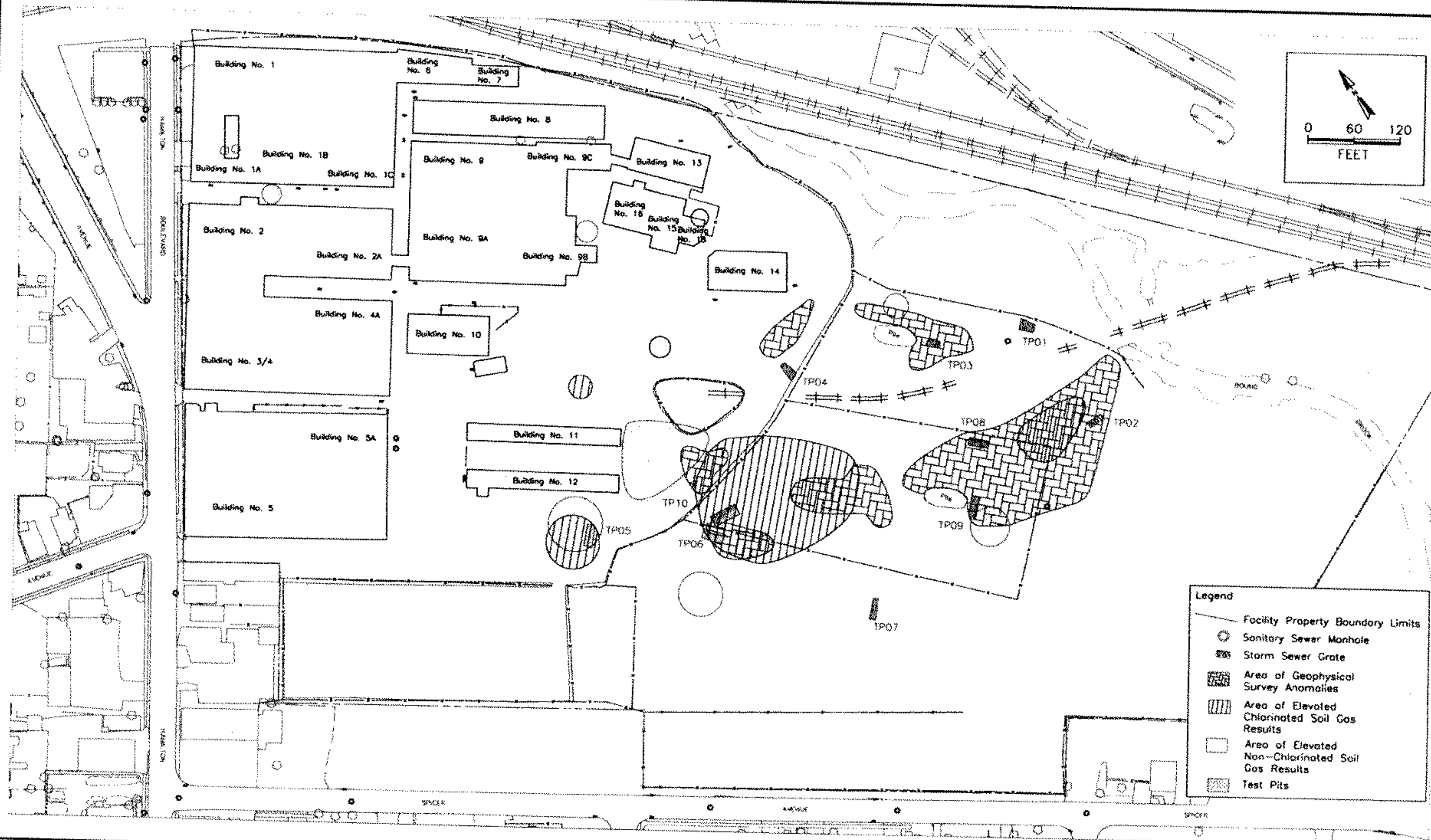
The ROD indicates that the selected remedy for the site soils includes a combination of alternatives S-3 and S-5. This selected remedy includes excavation of an estimated 7,500 cubic yards of contaminated soil and debris from the capacitor areas described above and transportation for disposal off site, with treatment as necessary. Although the Capacitor Disposal Area poses a principal threat, treatment of all of the excavated debris was not considered because of the nature of the waste, which is primarily debris, and not amenable to treatment by low temperature thermal desorption, the selected technology for treatment of site soils. The soil and debris from the Capacitor Disposal Area, with PCB concentrations greater than 50 ppm would be transported to a TSCA landfill.



FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE:	DWN.: CTS	DATE: 05/10/01	PROJECT NO.: 1945.1018
General Divided Facility Property Soil Areas Cornell-Dubilier Electronics Superfund Site Facility Soils and Buildings RI Report	CHKD: JG	REV.: 0	
	DES.: LEN	APPD: LH	FIGURE NO.: 4-10

→ RI Fig. 4-10



FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE:	DWN.: CTS	DATE: 05/09/01	PROJECT NO.: 1945.1018
Possible Source Areas from OU-2 RI Investigation Cornell-Dubilier Electronics Superfund Site Facility Soils and Buildings RI Report	CHKD: JG	REV.: 0	
	DES.: LEN	APPD: LH	FIGURE NO.: 4-3

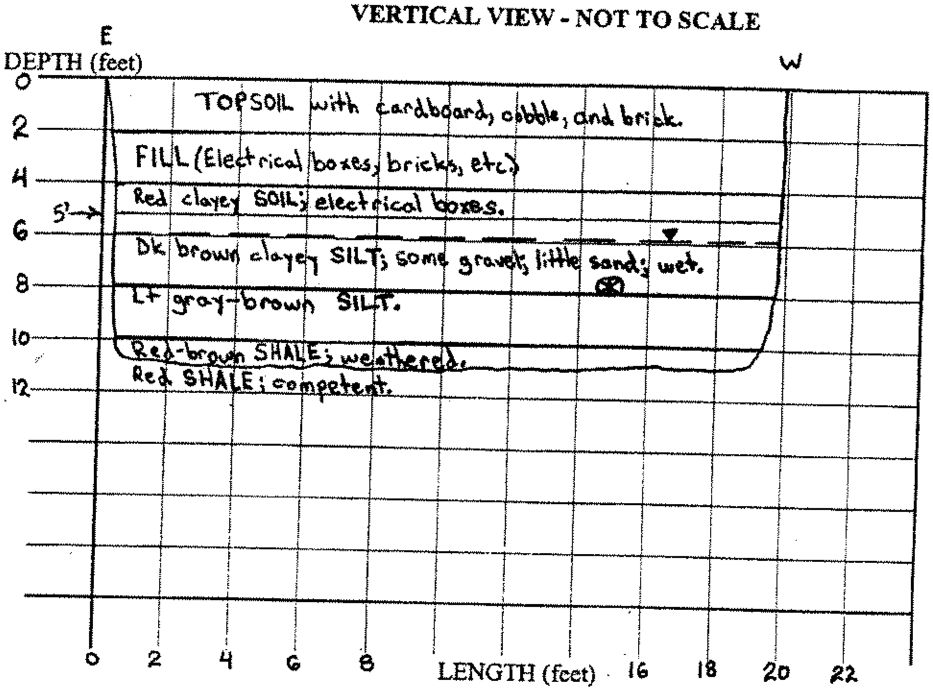
→ RI Fig. 4-3

TP-06

TEST PIT RECORD

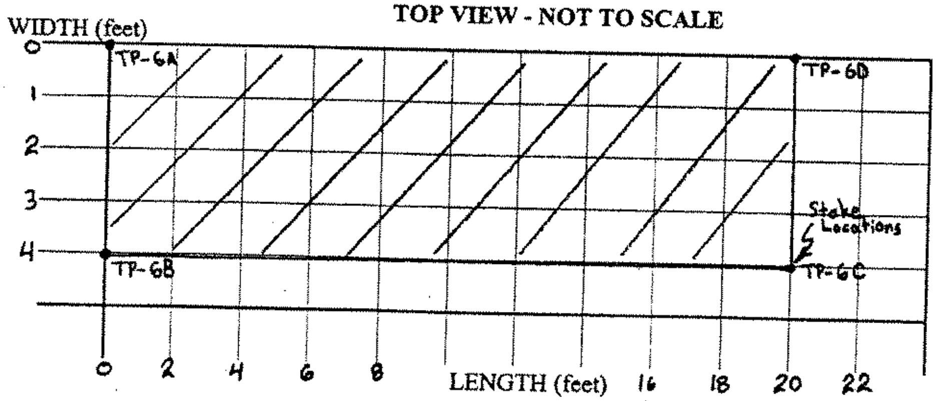
PROJECT:	Cornell-Dubilier Electronics Superfund	TEST PIT NUMBER:	TP06
PROJECT NO:	1945.1018.0300	DATE STARTED:	06/12/00
LOCATION:	West/southwest of truck driving school area.	DATE COMPLETED:	06/12/00
GEOLOGIST:	T. Fowler	GROUNDWATER DEPTH:	~ 6 ft bgs
EXCAVATION COMPANY:	Tabasco Drilling		Wet @~3 ft bgs

VERTICAL VIEW - NOT TO SCALE



Air Monitoring
Air monitoring with the PID
and FID measured 0 ppm in
test pit soils and breathing
zone, except:
FID = 26.9 ppm at 1507 in
test pit soils.
FID = 10.3 ppm at 1542 in
test pit soils.

TOP VIEW - NOT TO SCALE



NOTES: * Sample TP06-01 collected at approximately 7 to 8 ft bgs and 5 ft from the western edge. Groundwater sample TPW06-01 collected from test pit.

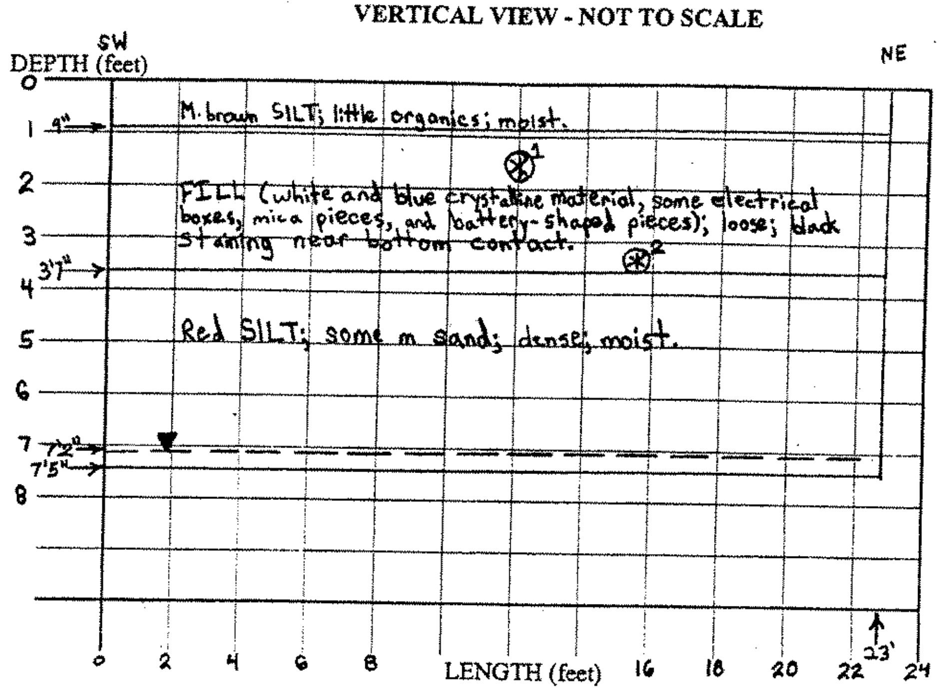
Legend:
PID: photo-ionization detector
FID: flame ionization detector
ppm: parts per million
ft: feet
bgs: below ground surface

TP-08

TEST PIT RECORD

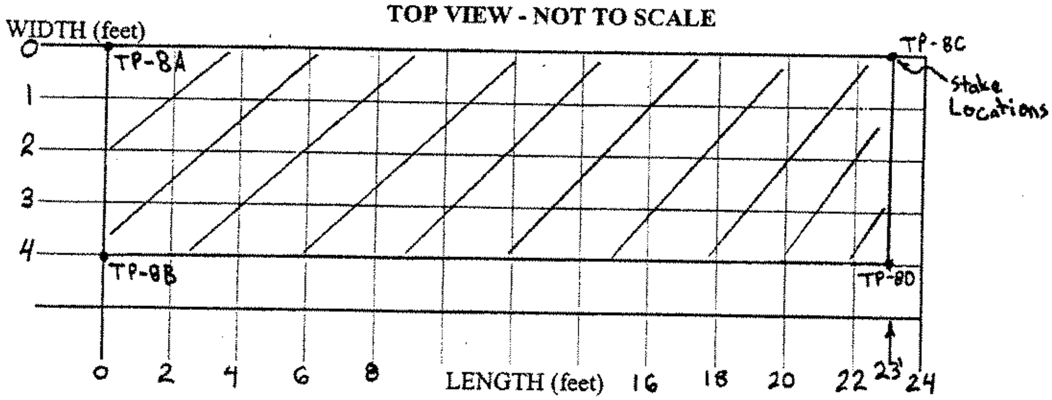
PROJECT:	Cornell-Dubilier Electronics Superfund	TEST PIT NUMBER:	TP08
PROJECT NO:	1945.1018.0300	DATE STARTED:	06/09/00
LOCATION:	South of fence inside truck school area.	DATE COMPLETED:	06/09/00
GEOLOGIST:	M. Greenberg	GROUNDWATER DEPTH:	7.2 ft bgs
EXCAVATION COMPANY:	Tabasco Drilling		

VERTICAL VIEW - NOT TO SCALE



Air Monitoring
Air monitoring with the PID
and FID measured 0 ppm in
test pit soils and breathing
zone.
Dust monitoring with the
mini-ram measured 0.0.

TOP VIEW - NOT TO SCALE



NOTES:
*1 Sample TP08-01 collected at 1.5 ft bgs and 11 ft from northeast edge.
*2 Sample TP08-02 collected at 3.5 ft bgs and 7.5 ft from northeast edge.
Groundwater sample TPW08-01 collected from test pit.

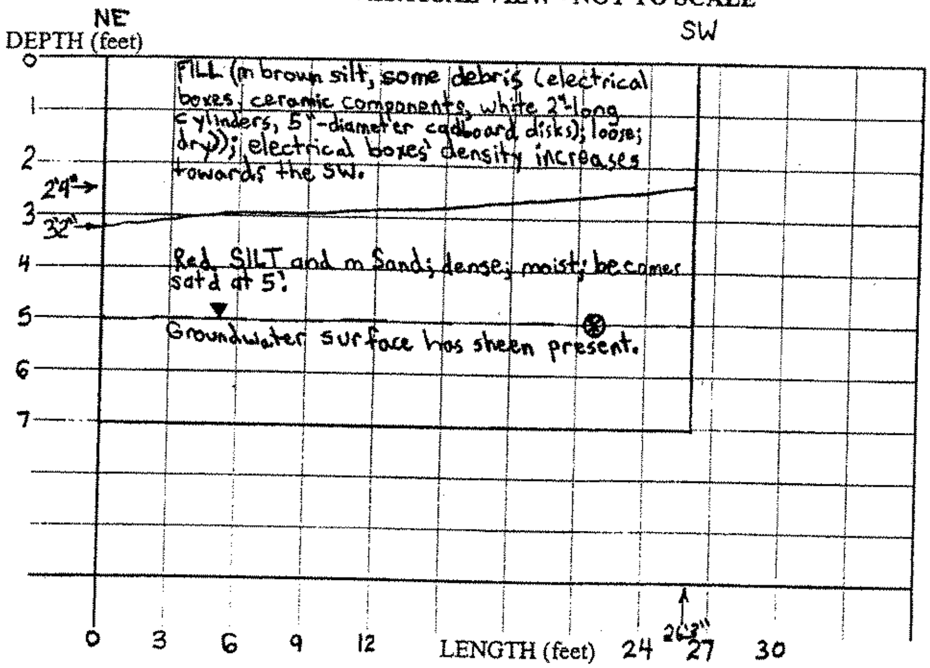
Legend:
PID: photo-ionization detector
FID: flame ionization detector
ppm: parts per million
ft: feet
bgs: below ground surface

TP-09

TEST PIT RECORD

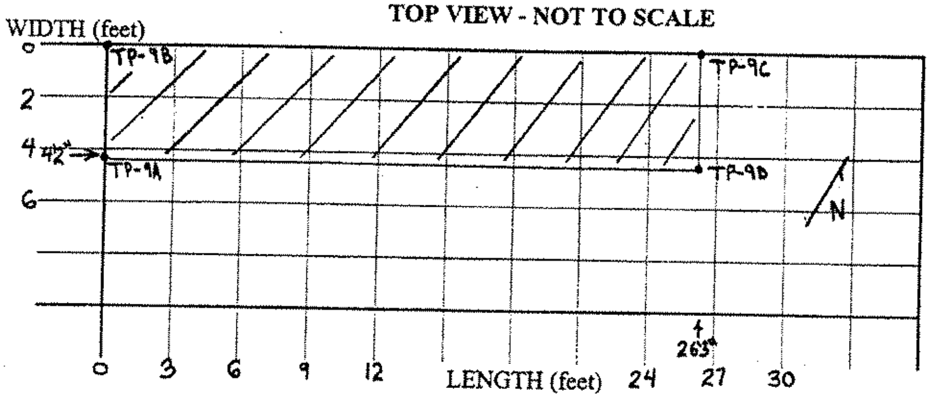
PROJECT:	Cornell-Dubilier Electronics Superfund	TEST PIT NUMBER:	TP09
PROJECT NO:	1945.1018.0300	DATE STARTED:	06/09/00
LOCATION:	West of eastern fence in truck school area.	DATE COMPLETED:	06/09/00
GEOLOGIST:	M. Greenberg	GROUNDWATER DEPTH:	5 ft bgs
EXCAVATION COMPANY:	Tabasco Drilling		

VERTICAL VIEW - NOT TO SCALE



Air Monitoring
Air monitoring with the PID
and FID measured 0 ppm
in the test pit soils and
breathing zone, except, in
test pit soils:
FID = 2.2 ppm at 1319.
FID = 13.3 ppm at 1403.
FID = 16.4 ppm at 1412.
In breathing zone:
FID = 2 ppm at 1403.
Dust monitoring with the
miniram measured 0.

TOP VIEW - NOT TO SCALE



NOTES: * Sample TP09-01 collected at 5 ft bgs and 22 ft from the northeast edge.
Groundwater sample TPW09-01 and duplicate, TPW99-01, collected from test pit.

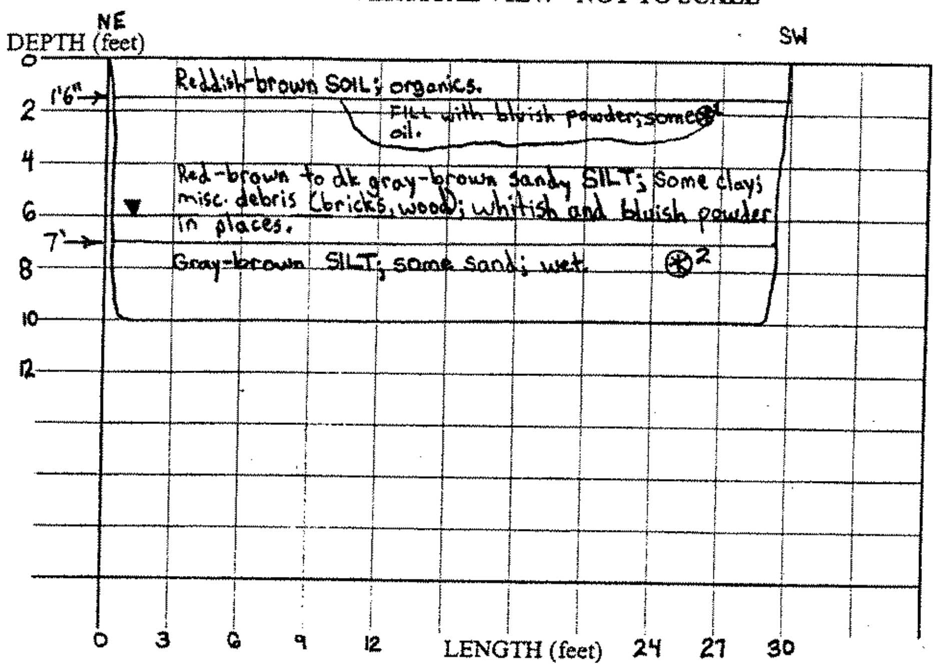
Legend:
PID: photo-ionization detector
FID: flame ionization detector
ppm: parts per million
ft: feet
bgs: below ground surface

TP-10

TEST PIT RECORD

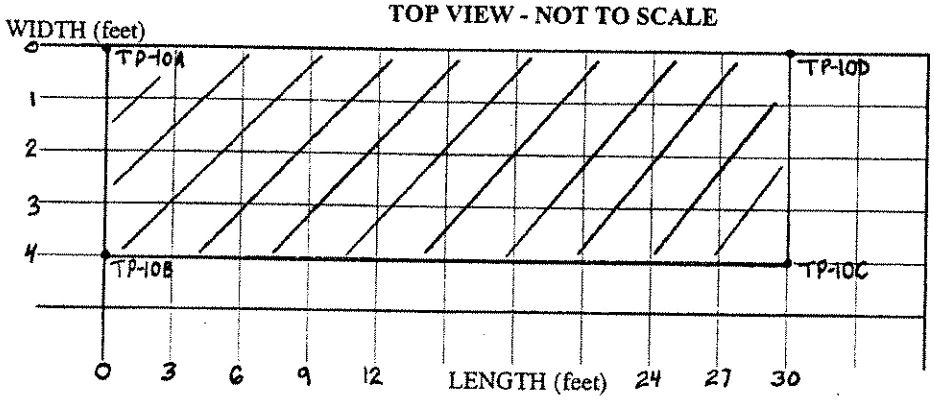
PROJECT: Cornell-Dubilier Electronics Superfund	TEST PIT NUMBER: TP10
PROJECT NO: 1945.1018.0300	DATE STARTED: 06/12/00
LOCATION: West/southwest area of truck driving school.	DATE COMPLETED: 06/12/00
GEOLOGIST: T. Fowler	GROUNDWATER DEPTH: ~ 6 ft bgs
EXCAVATION COMPANY: Tabasco Drilling	

VERTICAL VIEW - NOT TO SCALE



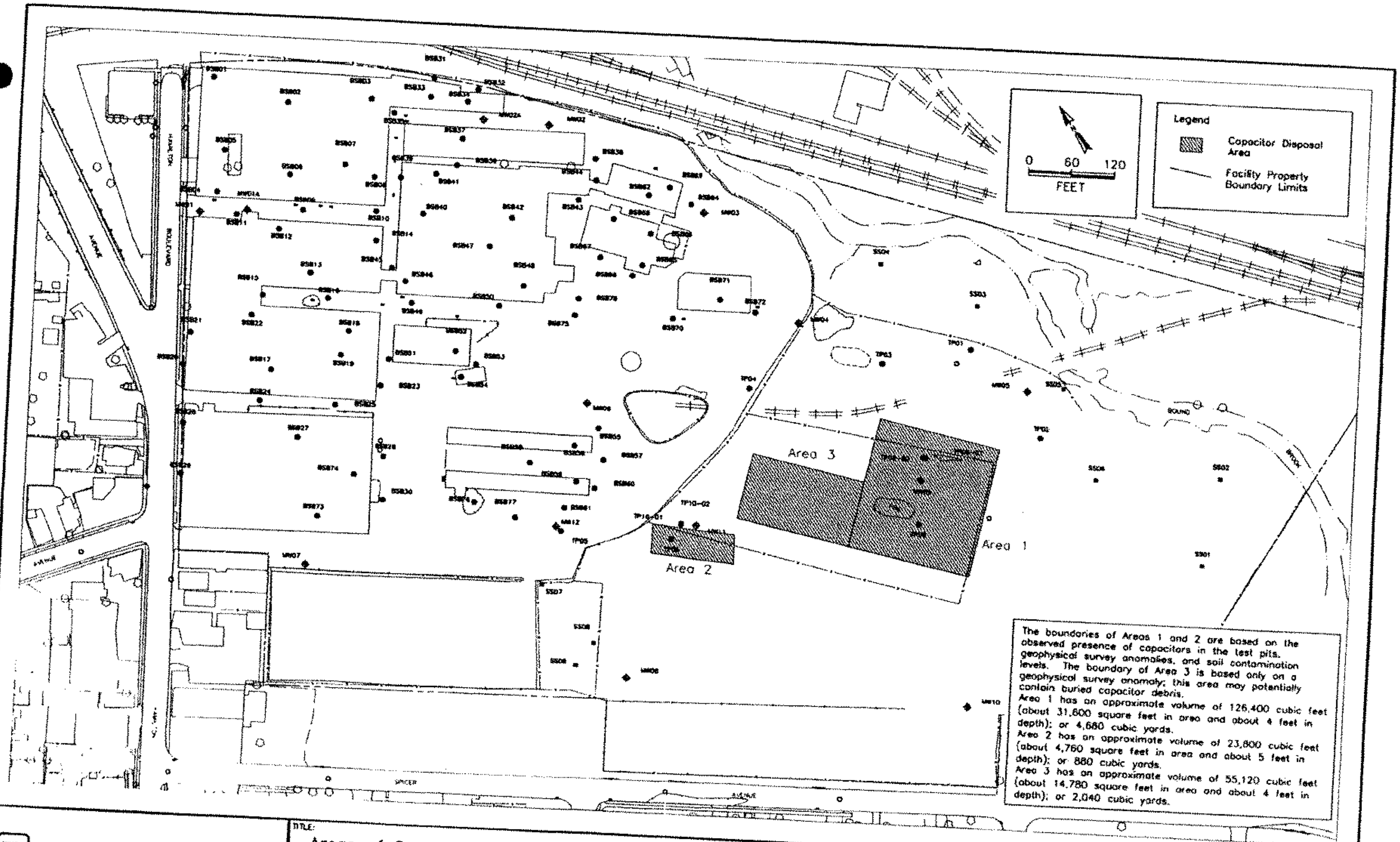
Air Monitoring
Air monitoring with the PID and FID measured 0 ppm in test pit soils and breathing zone except in test pit soils:
FID = 13.3 ppm, PID=7.6 ppm at 0919.
FID=24.4 ppm, PID=10.7 ppm at 0936.
FID=3.8 ppm, PID=8.3 ppm at 1008.
FID = 83.4 ppm at 1020.
FID = 2 ppm at 1032.
FID = 24 ppm at 1037.
FID=8.7 ppm, PID=10.7 ppm at 1042.
Dust monitoring with the mini-ram measured 0.0.

TOP VIEW - NOT TO SCALE



NOTES: *[1] Sample TP10-01 collected at approximately 2 ft bgs and 5 ft from southwest edge.
*[2] Sample TP10-02 collected at approximately 8 ft bgs and 6 ft from southwest edge.
Groundwater sample TPW10-01 collected from test pit.

Legend:
PID: photo-ionization detector
FID: flame ionization detector
ppm: parts per million
ft: feet
bgs: below ground surface



TETRA TECH FW, INC.

TITLE: Areas of Potentially Buried Capacitor Debris
Cornell-Dubilier Electronics Superfund Site
Facility Soils and Buildings FS Report

DWN: LEN	DATE: 03/29/04	PROJECT NO: 1945.2118
CHKD: BMS	REV: 1	FIGURE NO: 4-5

→ FS Fig. 4-5

Appendix D:

Development of Site-Specific, Risk-Based Preliminary Remediation Goals

APPENDIX D

DEVELOPMENT OF SITE-SPECIFIC, RISK-BASED PRELIMINARY REMEDIATION GOALS

Site-specific, risk-based preliminary remediation goals (PRGs) for certain Site-related chemicals of concern (COCs) were selected or developed for impacted environmental media within the OU4 Study Area based on the results of the baseline human health and ecological risk assessments (BHHRA and ERA, respectively) to support the remedial action objective (RAOs) established in this Feasibility Study (FS). The BHHRA and ERA determined that concentrations of a few chlorinated volatile organic compounds and total polychlorinated biphenyls (PCBs) in specific environmental media were associated with potential human and/or ecological health risks for some human or ecological receptors in one or more of the evaluated exposure units (EUs). Potential human health risks were defined as an incremental lifetime cancer risk greater than 10^{-4} (*i.e.*, 1 in 10,000) or a hazard quotient (HQ) or hazard index (HI) for adverse non-cancer health effect greater than 1. Potential ecological risks were defined as a HQ greater than 1. The specific environmental media (and the associated risk assessment component) include:

- Pore water (ERA)
- Surface water (ERA)
- Sediment (BHHRA and ERA)
- Floodplain soil (BHHRA and ERA)

Accordingly, the following RAOs were established:

- Groundwater:
  - Prevent release of groundwater constituents to surface water/sediment at unacceptable levels.
- Sediment/Floodplain Soils:
  - Prevent human exposure (direct contact and recreational exposures).
  - Prevent biota exposure; reduce PCB body burdens to levels acceptable for consumption.
  - Prevent migration of contaminated sediments.

The selection/development of PRGs for each environmental medium is described in the following sections. Human health risk-based PRGs were developed in general accordance with the approaches outlined in the U.S. Environmental Protection Agency's (USEPA) *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (1991) and *User's Guide* (November 2012) (2012) for development of their regional screening levels. PRGs were developed for target incremental lifetime cancer risks of 10^{-4} (1 in 10,000), 10^{-5} (1 in 100,000), and 10^{-6} (1 in 1,000,000) and for a target HQ and HI for adverse non-cancer health effects of 1. Ecological health risk-based PRGs were developed in general accordance with the approaches outlined in the USEPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (1997) and *Guidance for Developing Ecological Soil Screening Levels* (2005). PRGs were developed for a target HQ for adverse health effects of 1. For all ecological endpoints except the sediment and soil screening benchmarks, the PRG is the geometric mean of the sediment or soil concentrations resulting in a HQ of 1 based on the no observed adverse effect (NOAEL) and lowest observed adverse effect (LOAEL) for the critical body residues (CBRs) or toxicity reference values (TRVs) used to assess ecological risk. PRGs based on the geometric mean were derived in accordance with the USEPA's "Rule of Five" methodology (USEPA, 2007).

Porewater/Surface Water

Based on the results of the ERA, Site-related COCs in porewater include *cis*-1,2-dichloroethene, vinyl chloride, and total PCBs while Site-related COCs in surface water include total PCBs. The selected PRGs for these COCs, which include a USEPA standard, a New Jersey Department of Environmental Protection criterion, and a literature-based criterion, are presented in Table D-1.

Sediment

PRGs for total PCBs in sediment were developed. Based on the results of the BHHRA, direct contact-based PRGs were developed for sediment based on exposure equations and parameters for recreationists/sportsmen/anglers (both adult and adolescent), and outdoor workers (adult). These PRGs are protective of incidental ingestion of and dermal contact with sediment. The PRGs are listed in Table D-2. The PRG equations, exposure parameter values, and intermediate calculations are presented in Table D-3.

Also based on the results of the BHHRA, fish consumption-based PRGs were developed for sediment based on exposure equations and parameters for anglers (both adult and child). These PRGs, which are protective of ingestion of the fillet of locally-caught fish, were developed in a two-step process: 1) calculation of risk-based concentrations (RBCs) in fish fillet that are protective of human consumption and 2) development of PRGs for sediment based on site-specific biota-sediment accumulation factors (BSAF), lipid content in fish fillet, and total organic carbon (TOC) content in surface sediment.[1] Separate PRGs were developed based on consumption of predatory fish (*i.e.*, pumpkinseed sunfish) and bottom-feeding fish (*i.e.*, white sucker). Although the BHHRA also estimated potential health risks from consumption of locally-caught shellfish (*i.e.*, crayfish and Asiatic clams), PRGs based on consumption of shellfish were not developed, as the extent to which human consumption of these organisms in

[1] The relationships between PCB concentrations in surface sediment and fish tissue described below were based on Aroclor 1254 data. However, as noted in the Remedial Investigation Report, Aroclor 1254 was selected as a surrogate to represent the PCB Aroclor chemical group because of its predominance in the datasets and for ease of interpretation.

occurring, if at all, is less certain. The PRGs are listed in Table D-2.[2] The PRG equations, exposure parameter values, BSAFs, and intermediate calculations are presented in Table D-4.

A range of PRGs were also selected or developed for sediment based on the results of the ERA. These include PRGs protective of benthic organisms (*i.e.*, the sediment screening benchmark), invertebrates and fish [in terms of critical body residue (CBR)], bird eggs (in terms of bird critical egg residue), and avian and mammalian wildlife [in terms of toxicity reference value (TRV)]. The bird critical egg residue-based and TRV-based PRGs incorporate RBCs in invertebrates and forage fish that are protective of bird and mammalian consumption, BSAFs for invertebrates and forage fish, lipid content in invertebrates and forage fish, and TOC content in sediment. For avian and mammalian wildlife, the intake component of the calculations included exposure via the diet and incidental sediment ingestion. The mean site-specific sediment-to-invertebrate BSAF from the OU4 RI bioaccumulation tests was used. The PRGs are listed in Table D-2. The PRG equations, exposure parameter values, and BSAFs are presented in Table D-5a (based on invertebrate and fish CBRs), Table D-5b (based on critical bird egg residue), Table D-5c (based on avian wildlife), and Table D-5d (based on mammalian wildlife). The algebraic solution of the various equations used to calculate the PRGs, and an example calculation of the PRGs, are presented in Attachment D-1.

The highest total PCB concentration in sediment from the Ambrose Brook and Lake Nelson reference areas is also listed in Table D-2.

Burkhard (2009) notes that, "Probably the most important factor in measuring a BSAF with predictive power is the requirement that the sediment samples analyzed be reflective of the foraging range of the fish". Foraging ranges for the indicated predatory (*i.e.*, pumpkinseed sunfish) and bottom-feeding (*i.e.*, white sucker) fish were not found in readily available literature and online searches. Therefore, foraging ranges for the indicated fish were estimated based on total body lengths measured by the USEPA during their 1997and 2008 field investigations (USEPA, 1999 and USEPA, 2010)[3] and the following allometric relationship for freshwater fishes provided by Burkhard (2009):

[2] The New Jersey Department of Environmental Protection Agency fish advisories for Bound Brook and tributaries (i.e., the entire length including New Market Pond and Spring Lake) for all fish species, for high risk individuals and the general population, is "do not eat" (NJDEP, 2013). "High risk individuals" include infants, children, pregnant women, nursing mothers and women of childbearing age. The "general population" includes all others not in the high risk category. Generally PCB advisories for the general population are presented in meal frequencies (e.g., one meal per month or four meals per year), with the range based on an estimated 10^{-4} lifetime cancer risk from eating fish at the advisory level.

[3] Total body length data from both the 1997 and 2008 field investigations were used to provide a larger dataset to estimate foraging ranges although, as discussed subsequently, fish from the 1997 field investigation were not used to derive BSAFs because of concern regarding the validity of lipid content measurements in these fish.

$\ln H = -2.91 + 3.14\ HAB + 1.65 \ln L$

Eq. 1

where:

H is the home range size (m^2)
HAB is 0 for rivers and 1 for lakes
L is body length (mm)

A HAB of 0 was used for fish collected in Bound Brook and Green Brook and a HAB of 1 was used for fish collected in New Market Pond and Spring Lake. Foraging ranges for fish in Bound Brook and Green Brook estimated on an area basis (m^2) were converted to a linear basis (in m, then miles) by dividing by the average width of Bound Brook (4.6 m) for comparison to the distance between the sediment sampling locations. The following linear foraging ranges were estimated for fish in Bound Brook and Green Brook:

Fish Type	Fish Species	Estimated Linear Foraging Range (miles)
Predatory	Pumpkinseed sunfish	0.01 – 0.03
Bottom-feeding	White sucker	0.01 – 0.14

Generally, site-specific BSAFs for fish fillet and forage fish whole-body tissues are developed based on measured contaminant concentrations in fish fillet or forage fish and corresponding concentrations measured in surface sediment. For the OU4 Study Area, the contaminant is total PCBs, represented as Aroclor 1254.[4] The BSAF calculation also requires corresponding lipid content in the fish and TOC in the sediment. The standard formula for calculating the BSAFs is given by the following equation Burkhard (2009):

$$BSAF = \frac{C_{fish}/f_{lipid}}{C_{s-oc}}$$

Eq. 2

where:

C_{fish} = Aroclor 1254 concentration in an individual tissue sample in mg/kg, wet weight
f_{lipid} = lipid fraction in the tissue sample in g-lipid/g-tissue, wet weight
BSAF = biota-sediment accumulation factor in g-TOC/g-lipid
C_{s-oc} = TOC-normalized Aroclor 1254 sediment concentration in mg/kg, dry weight

[4] Aroclor 1254 concentrations were taken to represent Total PCB concentrations since this Aroclor was the reported form of PCBs in all Aroclor-based analyses of sediment and tissue samples. Other Aroclors were typically not detected.

This formula is based on the premise that tissue and sediment concentrations are linearly related, *i.e.,* that the BSAF is constant across any range of sediment or fish tissue concentrations. As will be described below, this was not the case for the 2 to 3 order-of-magnitude range in sediment and tissue concentrations observed for the OU4 Study Area. To incorporate this nonlinearity, the formula was modified to allow for a nonlinear response. The derivation is also described below.

The correlation between fish tissue concentrations and sediment concentrations was analyzed by:

- Evaluating temporal and spatial Aroclor 1254 fish tissue concentrations with respect to river mile and sampling event,
- Evaluating Aroclor 1254 surface sediment concentrations and Be-7 bearing surface sediment concentrations with respect to river mile and sampling event, and
- Examining the relationship between fish tissue concentrations and sediment concentrations to establish the best approach for deriving site-specific BSAFs.

<u>Aroclor 1254 Tissue Data</u>

- Fish fillet: Data for pumpkinseed sunfish (as a representative predatory fish) and white sucker (as a representative bottom-feeding fish) were used to examine the correlation between Aroclor 1254 concentrations in fish tissue and sediment. The data are summarized in Tables D-6 and D-7, for pumpkinseed sunfish fillet and white sucker fillet, respectively. The selection of these two species was based on the availability of data over a large extent of Bound Brook and from two sampling events: 1997 (USEPA, 1999) and 2008 (USEPA, 2010). The first objective of this analysis was to evaluate the spatial and temporal trends in Aroclor 1254 tissue concentrations. Plots of Aroclor 1254 tissue concentration vs. river mile were created for each species. The plots were used to review tissue concentrations between the two sampling events (temporal trends) and to identify differences across river mile (spatial trend). Figures D-1 and D-2 indicate that the 1997 and the 2008 tissue concentrations are similar, for both pumpkinseed sunfish fillet and white sucker fillet, respectively. However, Figures D-3 and D-4 indicate that when the data were reviewed as lipid-normalized tissue concentrations, 1997 tissue concentrations are different from 2008 tissue concentrations, for both pumpkinseed sunfish fillet and white sucker fillet, respectively. Figures D-5 and D-6 confirm that the 1997 and 2008 tissue concentrations are significantly different, for both pumpkinseed sunfish fillet and white sucker fillet, respectively. As shown in these figures, the difference in concentrations is statistically significant, with the 2008 concentrations greater than the 1997 results based on the Tukey-Kramer honestly significant difference test5. In contrast, the lipid content of the 1997 fish

[5] The Tukey-Kramer honestly significant difference test is an analysis of variance that is used to identify population means that are significantly different from each other. The Tukey-Kramer circles shown in the figures represent the mean concentration (center of the circle) and its uncertainty (circle radius) for each sample group. Circles that do not touch or intersect only slightly are indicative of sample groups that are statistically different from each other. The size of the circle reflects the uncertainty in the mean value, with larger circles reflecting larger uncertainty. Thus, small sample size or highly variable data sets have larger circles than those reflecting large data sets or low variability data sets. In instances where the circles intersect by an angle of more

was significantly different and much higher than the 2008 fish: 4.7 percent vs. 1 percent for pumpkinseed sunfish (Figure D-7) and 10.4 percent vs. 0.97 percent for white sucker (Figure D-8). Based on data presented in the USEPA's User's Guide and Technical Documentation, KABAM Version 1.0 (Kow (based) Aquatic BioAccumulation Model) (USEPA, 2009), the lipid content for pumpkinseed sunfish and white sucker typically range from 0.7 percent to 2.3 percent. Therefore, due to the unusually high lipid content in the 1997 fish and the resulting large difference in the lipid-normalized concentrations relative to 2008, only the data for the 2008 fish were used to evaluate the correlation between tissue and sediment concentrations.

- Forage fish: Pumpkinseed sunfish whole-body Aroclor 1254 data were used to examine the correlation between tissue and sediment concentrations based on the available data from the 1997 and 2008 sampling events. These data are summarized in Table D-8. The available data were limited to sampling locations between RM5 and RM8. Like the fillet samples, the 1997 samples were reported with lipid concentrations much greater than those observed in 2008 (Figure D-9, 5 percent vs. 3 percent). As a result, only the data for the 2008 fish were used to evaluate the correlation between tissue and sediment concentrations. A plot of lipid-normalized tissue concentration vs. river mile is presented in Figure D-10.
- For both the white sucker and the pumpkinseed tissue data, the selection of the 2008 tissue data over the 1997 data likely represents a more protective basis to assess the relationship between tissue and sediment concentrations, since the 2008 tissue data represent the higher lipid-normalized concentrations. This is discussed further below.

Aroclor 1254 Sediment Data

- Surface sediment: The surface sediment data used in the analysis were obtained from the 2011 sampling event during the OU4 RI (hereinafter, 2011 sampling event).[6] Surface sediment data from the USEPA's 1997 sampling event (USEPA, 1999) were not used because the reported TOC data are not supportable. Similar to the lipid content data, TOC measurements for sediment samples from the 1997 sampling event were significantly higher than those from the 2011 sampling event, as shown in Figure D-11, typically five times higher than the 2011 sediment samples (11.3 percent vs. 2.3 percent). Based on this observation, the 1997 TOC data to be used in normalizing the sediment concentrations for the BSAF calculations were considered not consistent with the 2011 TOC data. Lacking TOC data on a basis comparable to the 2011 sediment data, the 1997 sediment data were excluded from the BSAF calculation. The surface sediment data from the 2011 sampling event were ultimately used to provide the sediment exposure basis for the BSAF calculations with the white sucker fillet concentrations (see the following section, Development of Biota-Sediment Accumulation Factor).

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than 90 degrees, or if they are nested, the means are not considered significantly different at an alpha level of 0.05 (95 percent confidence level).

[6] The Final Remedial Investigation Report, Section 8.2.1 indicates that, "A comparison of current and historical surface sediment data (1997-2011) revealed little change in Aroclor 1254 concentrations over the past 14 years, suggesting limited natural recovery of PCB contamination in Bound Brook. This observation is consistent with trends in the PCB concentrations observed in sediments deposited in New Market Pond over the past 20 years and detected in the high resolution sediment core."

- Be-7 bearing surface sediment: The Be-7 bearing surface sediment data used in the analysis were derived from the 2011 sampling event. Be-7 was only obtained as part of the 2011 sediment sampling program. As described below, these data were used to provide the sediment exposure basis for the BSAF calculations for the pumpkinseed sunfish fillet and whole body tissue concentrations (see the following section, Development of Biota-Sediment Accumulation Factor).

Development of Biota-Sediment Accumulation Factors

Site-specific BSAFs were developed based on the correlation between Aroclor 1254 tissue and sediment concentrations. An important component in the development of the BSAFs is the creation of matched pairs of tissue and sediment concentrations. However, because of the fish life histories (*e.g.*, habitat, mobility) and the temporally separate tissue and sediment sampling events, in most cases, the most relevant sediment concentration to “match” with each tissue concentration was not intuitively obvious. Making the best data “match” required consideration of the tissue sample location and incorporation of enough sediment data to produce a robust estimate of the corresponding local mean sediment concentration. Surface sediment concentrations were examined over a 0.5-mile window encompassing each tissue sample location. That is, corresponding surface sediment concentrations were estimated as the mean of all sediment samples in an area ± 0.25 miles about each tissue sampling location (see Figures D-12 through D-14 for pumpkinseed sunfish fillet, white sucker fillet, and pumpkinseed sunfish whole body, respectively). Although these distances are greater than the estimated foraging ranges noted above, they were necessary to incorporate enough sediment data. It is unlikely that averaging over a 0.5 mile window will introduce substantive uncertainty into the analysis since there is much greater variation at most locations than there is in the averages between any two adjacent windows. This can be directly observed in Figures D-13 to D-15. For example, the average Aroclor 1254 concentration in surface sediments between RM 4 and RM 6 varies between 100 and 300 mg/kg-TOC but the variation among individual samples in the interval between RM 4.5 to 5.0 is approximately two orders of magnitude.

Each figure presents lipid-normalized tissue concentrations and mean TOC-normalized surface sediment concentrations *vs*. river mile. Tissue concentrations were normalized to lipid content and surface sediment concentrations were normalized to TOC content, which is a standard approach for BSAF estimation, based on the fact that most organic chemicals associate with the organic fraction of the sediment.

As noted previously, calculation of the BSAFs for each tissue type examined indicated that the relationship between sediment and tissue was not constant across the range of tissue and sediment concentrations available. Instead the BSAF values increased at lower concentrations, indicating that tissue concentrations were higher per unit mass of sediment concentration. To reflect the greater sensitivity of the fish at lower concentrations while also including the response at higher concentrations, a nonlinear relationship was derived relating tissue and sediment.

Equation 2 can be rearranged, substituting the coefficient "a" for the BSAF value. Additionally, an exponent "b" is added to the TOC-normalized concentration to account for a nonlinear response between sediment and tissue, yielding a power model of the form:

$$\frac{C_{fish}}{f_{lipid}} = a(C_{s-oc})^b \qquad \text{Eq. 3}$$

where:

C_{fish}	=	Aroclor 1254 concentration in an individual tissue sample in mass/mass tissue, wet weight
f_{lipid}	=	lipid fraction in the tissue sample in g-lipid/g-tissue, wet weight
a	=	the coefficient on the TOC-normalized concentration in g-TOC/g-lipid
C_{s-oc}	=	mean TOC-normalized Aroclor 1254 sediment concentration, mass/mass sediment dry weight, determined as described above
b	=	exponent on the TOC-normalized concentration

This equation can be converted to a form suitable for linear regression by log-transforming the sediment and tissue concentrations. The transformed model is:

$$\log\left(\frac{C_{fish}}{f_{lipid}}\right) = a' + b\ log(C_{s-oc}) \qquad \text{Eq. 4}$$

where:

a'	=	intercept
b	=	slope

In a log-log regression, the slope of the regression line (b) is not the BSAF but rather it is the exponent on the TOC-normalized concentration. The coefficient a' is the log of the coefficient a. If the coefficient b converges to 1, the coefficient a' converges to the log of the BSAF term in equation 2 and the relationship becomes the linear expression given in Equation 2. When the slope is not equal to 1, the relationship between sediment and tissue concentrations is non-linear.

The regression analysis method was used to evaluate the correlation between tissue and surface sediment concentrations. The log-log regression for the white sucker fillet is presented in Figure D-15. The adjusted r-squared value obtained by the fit was 0.83.[7] The slope of the regression was 0.833, which indicates that the slope of white sucker fillet data curve is close to 1, indicating a relatively minor nonlinear component to the relationship between tissue and sediment.

[7] Note that one outlier white sucker sample was excluded from the regression, based on the fact that it was about 40 times higher than all other white sucker tissue measurements upstream of the site. While the source of the outlier is unknown, it may simply represent a downstream animal that had recently migrated upstream, given the similarity of its body burden to that observed in specimens collected downstream of the site.

However, the relationship is derived using a relatively poorly constrained low-concentration sediment-tissue pair. Specifically, while eight surface sediment samples were used to characterize the upstream fish tissue sampling location (*i.e.*, the lower fish tissue concentrations), six of the samples were reported as non-detects (see Figure D-13 and Table D-7). Thus the sediment-tissue relationship at the lower fish tissue concentrations was estimated with greater uncertainty than at the higher tissue concentrations.[8] Given the fact that white suckers are bottom feeders, it was felt that this relationship was still the best site-specific relationship that could be derived with the data available, albeit with greater uncertainty at low concentrations. Using the results given in Figure D-15, the following regression equation was used to develop PRGs for sediment based on bottom-feeding fish (*i.e.*, white sucker) fillet:

$$\log\left(\frac{C_{fish}}{f_{lipid}}\right) = 1.049 + 0.833\ log(C_{s-oc})$$

where:

mean lipid content = 0.00973
mean TOC content = 0.0265

To simplify the PRG calculations, the equation was reduced to:

$$C_s = 1.955*\exp(\ln(C_{fish})/0.833)$$

where C_{fish} and C_s are in mg/kg.

Figure D-16 presents the white sucker fillet *vs.* surface sediment concentrations. The figure shows the tissue, sediment matched pairs at each fish sampling location and the model curve through the data points. The figure also shows a line representing a linear fit to the data. Note the poor agreement between the linear line and the observations at low concentrations, indicating the need for the nonlinear adjustment provided by the coefficient "b" in the model. By using a log-log regression, the analysis gives greater weight to the observations at low concentrations than a simple linear regression through the untransformed data. That is, the log-log curve lies closer to the data at low concentrations than does the linear regression. The log-log curve is considered more protective of human health and the environment since this regression will prescribe a lower sediment concentration for a given tissue concentration at the low tissue concentration range.

The log-log regressions for the predatory fish are presented in Figures D-17 (pumpkinseed sunfish fillet) and D-18 (pumpkinseed sunfish whole body) using the results from the 0 to 6 inches samples. In both regressions, the slopes are on the order of 0.5 to 0.6, indicating much

[8] Mean of the eight sediment sample results was obtained by averaging the two detections at approximately 30 mg/kg-OC each with half the detection limit for the six nondetects at approximately 1 mg/kg-OC each, yielding a mean of 7.7 mg/kg-OC. Whether the detection limit, half the detection limit or zero is substituted in the calculation of the mean, it makes little difference on the estimate of the mean itself (range from roughly 7.5 to 9 mg/kg-OC). The greater uncertainty in this estimate of the mean stems from the great difference in value between the two detected results and the six nondetect results.

greater nonlinearity in the relationship between tissue and sediment for the pumpkinseed. These coefficients correspond to a square-root dependence between sediment and tissue concentrations, and imply a weaker relationship between the sediment concentrations and the tissue concentrations than observed for the white sucker. Additionally, like the white sucker regression, the lower sediment concentrations were estimated with greater uncertainty because of the large number of non-detects in surface sediment samples from the upstream fish tissue sampling location (see Figures D-12 and D-14 and Tables D-6 and D-8). Given the stronger nonlinearity and the uncertainty at lower concentrations, the pumpkinseed tissue data were examined against Be-7 bearing sediment in hope of obtaining a more linear result with less uncertainty at low concentrations. Pumpkinseed sunfish are generally considered primary water column feeders, consuming prey from the water column (Jordan et al., 2009). It was felt that PCB concentrations on Be-7 bearing sediments, which represent deposited water column suspended matter accumulated over the previous 6 to 12 months, would be more closely correlated with pumpkinseed tissue concentrations.

The Be-7 bearing surface sediment concentrations for use in the regression were estimated as the mean of all Be-7 bearing sediment samples within the noted reach (*i.e.*, $\pm$ 0.25 miles) for each tissue sampling location. These sediment concentrations are provided in Tables D-6 and D-8. Figures D-19 and D-20 presented matched pairs of Be-7 bearing surface sediment and tissue concentrations for each fish sampling location for pumpkinseed sunfish fillet and whole body.[9] In this manner, mean Be-7 bearing surface sediment concentrations matched with mean tissue concentrations at each fish sampling location. As described above, a log-transform regression analysis was used to examine the correlation between Be-7 bearing surface sediment and tissue concentrations. Figures D-21 and D-22 present the log-transforming regression curves for pumpkinseed sunfish fillet and whole body, respectively. The slopes of both curves are much closer to 1, at 0.83 and 0.90 for pumpkinseed fillet and whole body tissue concentrations, respectively, indicating a more linear response between recently deposited sediments and pumpkinseed tissue concentrations, relative to the relationship based on the 0 to 6 inch samples. Additionally, the adjusted r-squared value for the fillet has increased relative to the 0-6 inches sediment sample basis. These regressions were not subject to an increased uncertainty in the low concentration values since all Be-7 sediment samples had quantifiable results. As a result, the relationships described in Figures D-21 and D-22 were considered the best fits for the pumpkinseed results.

The log-transforming equation for pumpkinseed sunfish fillet is:

[9] One Be-7 sample, at RM 5.75, was excluded from the analysis based on the large difference between this sample and the other samples in this section of the river. Exclusion of this point results in a lower mean value for this river section, which in turn yields a more protective relationship between tissue and sediment. That is, a regression excluding this data point will prescribe a lower sediment concentration for a given tissue concentration.

$$\log\left(\frac{C_{fish}}{f_{lipid}}\right) = 0.918 + 0.833\ log(C_{s-oc})$$

where:

mean lipid content = 0.0116
mean TOC content = 0.0513

To simplify the PRG calculations, the equation was reduced to:

$$C_s = 3.580*\exp(\ln(C_{fish})/0.833)$$

where C_{fish} and C_s are in mg/kg.

Figure D-23 presents the pumpkinseed sunfish fillet *vs*. Be-7 surface sediment concentrations. The figure shows the tissue, sediment matched pairs at each fish sampling location and the model curve through the data points. The figure also shows a line representing a linear fit to the data. Note the poor agreement between the linear line and the observations at low concentrations, indicating the need for the nonlinear adjustment provided by the coefficient "b" in the model.

The log-transforming equation for pumpkinseed sunfish whole body is:

$$\log\left(\frac{C_{fish}}{f_{lipid}}\right) = 1.03 + 0.897\ log(C_{s-oc})$$

where:

mean lipid content = 0.0334
mean TOC content = 0.0513

To simplify the PRG calculations, the equation was reduced to:

$$C_s = 0.719*\exp(\ln(C_{fish})/0.897)$$

where C_{fish} and C_s are in mg/kg.

Figure D-24 presents the pumpkinseed sunfish whole body *vs*. Be-7 surface sediment concentrations. The figure shows the tissue, sediment matched pairs at each fish sampling location and the model curve through the data points. It also shows a line representing a linear fit to the data. Like the other two models, there is poorer agreement between the linear line and the observations at low concentrations.

For all three tissue-sediment regressions, the use of the log-log regression gives greater weight to the observations at low concentrations than a simple linear regression through the untransformed data. Based on the risk assessment results, the lower tissue concentrations are likely to represent target concentrations to be achieved by any given remedial action. Thus, it is important for the regression models to be more accurate in this area of interest. The log-log regressions more accurately represent the lower concentration tissue-sediment pairs, as is evident in Figures D-16, D-23 and D-24. Additionally, each of these models describes a condition wherein a lower sediment concentration is correlated to the observed fish tissue concentrations than what would be given by a linear regression (*i.e.*, the model curve lies above the linear curve at low concentrations in all three instances.). This represents a more protective relationship between sediment and tissue since it will prescribe a lower sediment concentration target for any given tissue concentration target determined from the risk assessments.

Floodplain Soil

PRGs for total PCBs in floodplain soil were developed. Based on the results of the BHHRA, direct contact-based PRGs were developed for floodplain soil, based on exposure equations and parameters for recreationists/sportsmen/anglers (adolescent), commercial/industrial workers (adult), and residents (both adult and child)[10]. These PRGs are protective of exposures from incidental ingestion of and dermal contact with soil, and inhalation of respirable particulates released from soil. The PRGs are listed in Table D-9. For the resident, the lower of the PRGs for the adult and child are listed. The PRG equations, exposure parameter values, and intermediate calculations are presented in Table D-10.

A range of PRGs for floodplain soil are also presented in Table D-9 based on the results of the ERA. These include soil screening benchmarks selected as protective of terrestrial plants/invertebrates and birds/mammals and values developed as protective of food-web exposure of select wildlife receptors. Food web-based PRGs were developed based on exposure equations and parameters for insectivorous birds (*i.e.*, for American robin) and insectivorous mammals (*i.e.*, for short-tailed shrew). The PRGs incorporate RBCs in dietary items that are protective of wildlife ingestion, the mean site-specific soil-to-invertebrate bioaccumulation factor (BAF) from the OU4 RI bioaccumulation tests, and a literature-based soil-to-plant BAF. For avian and mammalian wildlife, the intake component of the calculations included exposure via the diet and incidental soil ingestion. The PRG equations, exposure parameter values, BAFs, and intermediate calculations are presented in Table D-11. The algebraic solution of the equations

[10] While residences are located within the Our Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario evaluated in the Risk Assessment, and included herein, is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

used to calculate the PRGs, and an example calculation of the PRGs, are presented in Attachment D-1.

The total PCB concentration in the floodplain soil sample from the Ambrose Brook reference area is also listed in Table D-9.

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Table D-1
RISK-BASED PRGs FOR SURFACE WATER
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Chemical of Concern	PRG (μg/L)
cis-1,2-Dichloroethene [1]	590
Vinyl chloride [2]	930
Total PCBs [3]	0.014

Notes:
1. Tier II Secondary Chronic Value (Suter and Tsao, 1996)
2. NJDEP Ecological Screening Criterion
3. National Recommended Water Quality Criterion

μg/L = microgram per liter

Table D-2
SITE-SPECIFIC, RISK-BASED PRGs FOR TOTAL PCBs IN SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Basis	**PRG (mg/kg, dw)**
Human/Bottom-Feeding Fish Consumption - 10^{-6} Cancer Risk (Angler - adult/child) [2]	2.1E-03
Human/Predatory Fish Consumption - 10^{-6} Cancer Risk (Angler - adult/child) [2]	3.8E-03
Human/Bottom-Feeding Fish Consumption - 10^{-5} Cancer Risk (Angler - adult/child) [2]	2.1E-02
Fish CBR	2.2E-02
Human/Predatory Fish Consumption - 10^{-5} Cancer Risk (Angler - adult/child) [2]	3.8E-02
Human/Bottom-Feeding Fish Consumption - Non-cancer Hazard (Angler - child)	4.1E-02
Bird Egg CBR	5.1E-02
Sediment Screening Benchmark [3]	6.0E-02
Reference Area Sediment [4]	6.4E-02
Human/Predatory Fish Consumption - Non-cancer Hazard (Angler - child)	7.6E-02
Human/Bottom-Feeding Fish Consumption - 10^{-4} Cancer Risk (Angler - adult/child) [2]	2.1E-01
Human/Predatory Fish Consumption - 10^{-4} Cancer Risk (Angler - adult/child) [2]	3.8E-01
Invertebrate CBR	6.1E-01
Insectivorous Bird TRV	7.7E-01
Human/Direct Contact - 10^{-6} Cancer Risk (R/S/A - adult)	1.1E+00
Insectivorous Mammal TRV	1.9E+00
Piscivorous Bird TRV	4.7E+00
Piscivorous Mammal TRV	1.1E+01
Human/Direct Contact - 10^{-5} Cancer Risk (R/S/A - adult)	1.1E+01
Human/Direct Contact - Non-cancer Hazard (R/S/A - adolescent)	1.3E+01
Human/Direct Contact - Non-cancer Hazard (Outdoor worker - adult) [5]	1.5E+01
Herbivorous Mammal TRV	1.8E+01
Human/Direct Contact - 10^{-6} Cancer Risk (Outdoor worker - adult) [5]	2.7E+01
Human/Direct Contact - 10^{-4} Cancer Risk (R/S/A - adult)	1.1E+02
Human/Direct Contact - 10^{-5} Cancer Risk (Outdoor worker - adult) [5]	2.7E+02
Human/Direct Contact - 10^{-4} Cancer Risk (Outdoor worker - adult) [5]	2.7E+03

Notes:
1. For direct contact by Recreationist/Sportsman/Angler (R/S/A) and fish consumption by Angler, the lowest PRG for the different population ages evaluated in the forward risk assessment are presented. The gray-highlighted PRGs are for illustration purposes; exposure to total PBCs did not pose unacceptable cancer risk or non-cancer hazard in the forward risk assessment.
2. For cancer risk-based PRGs, exposure was based on 6 years as child and 24 years as an adult.
3. Consensus-based sediment quality quideline, threshold effect concentration (MacDonald, 2000).
4. Highest reference area sediment concentration for Ambrose Brook (2.61E-03 to 2.98E-02 mg/kg) and Lake Nelson (6.4E-02 mg/kg).
5. The forward risk assessment for these receptors evaluated exposure to all sediment.
TRV = Toxicity reference value
mg/kg = milligram per kilogram
dw = dry weight

Table D-3
HUMAN HEALTH/DIRECT CONTACT PRGs FOR TOTAL PCBs IN SURFACE SEDIMENT AND ALL SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

PRG	Non-cancer THQ = 1			10^{-6} Cancer Risk		
	Surface Sediment		All Sediment	Surface Sediment		All Sediment
	Recreationist/ Sportsman/Angler		Outdoor Worker	Recreationist/ Sportsman/Angler		Outdoor Worker
	Adult mg/kg	Adolescent mg/kg	Adult mg/kg	Adult mg/kg	Adolescent mg/kg	Adult mg/kg
PRG-ing	1.0E+02	3.6E+01	2.6E+01	6.0E+00	5.2E+00	4.5E+01
PRG-derm	2.4E+01	2.0E+01	3.7E+01	1.4E+00	3.0E+00	6.5E+01
PRG-total	**1.9E+01**	**1.3E+01**	**1.5E+01**	**1.1E+00**	**1.9E+00**	**2.7E+01**

Equations

Non-Cancer Hazard

$$\text{PRG-ing} = \frac{\text{THQ x ATnc x BW x RfD}}{\text{EF x ED x IR x CF1}}$$

$$\text{PRG-derm} = \frac{\text{THQ x ATnc x BW x RfD}}{\text{EF x ED x EV x SA x AF x ABS x CF1}}$$

$$\text{PRG-total} = \frac{1}{\text{1 /SL-ing + 1/SL-derm}}$$

Cancer Risk

$$\text{PRG-ing} = \frac{\text{TR x ATc x BW}}{\text{CSF x EF x ED x IR x CF1}}$$

$$\text{PRG-derm} = \frac{\text{TR x ATc x BW}}{\text{CSF x EF x ED x EV x SA x AF x ABS x CF1}}$$

$$\text{PRG-total} = \frac{1}{\text{1 /SL-ing + 1/SL-derm}}$$

Parameter Values

Symbol	Units	Recreationist/ Sportsman/Angler		Outdoor Worker	Recreationist/ Sportsman/Angler		Outdoor Worker
		Adult hazard	Adolescent hazard	Adult hazard	Adult risk	Adolescent risk	Adult risk
THQ	unitless	1	1	1	N/A	N/A	N/A
TCR	unitless	N/A	N/A	N/A	1E-06	1E-06	1E-06
ATnc	days	10,950	4,380	365	N/A	N/A	N/A
ATc	days	N/A	N/A	N/A	25,550	25,550	25,550
BW	kg	70	49	70	70	49	70
RfD	mg/kg-d	2E-05	2E-05	2E-05	N/A	N/A	N/A
CSF	$(mg/kg\text{-}d)^{-1}$	N/A	N/A	N/A	2E+00	2E+00	2E+00
IR	mg/day	100	200	330	100	200	330
EF	days/year	50	50	60	50	50	60
ED	years	30	12	1	30	12	1
EV	events/day	1	1	1	1	1	1
SA	cm^2	6,200	5,000	3,300	6,200	5,000	3,300
AF	mg/cm^2-event	0.5	0.5	0.5	0.5	0.5	0.5
ABS	unitless	0.14	0.14	0.14	0.14	0.14	0.14
CF1	kg/mg	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06

Notes:
N/A = Not applicable
kg = kilogram
mg = milligram
cm = centimeter

Table D-4
HUMAN HEALTH/FISH CONSUMPTION PRGs FOR TOTAL PCBs IN SURFACE SEDIMENT
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

PRG	Predatory Fish				Bottom Feeding Fish			
	10^{-6} Cancer Risk		Non-cancer HQ = 1		10^{-6} Cancer Risk		Non-cancer HQ = 1	
	Angler		Angler		Angler		Angler	
	Adult/Child [1] mg/kg	Child mg/kg	Adult mg/kg	Child mg/kg	Adult/Child [1] mg/kg	Child mg/kg	Adult mg/kg	Child mg/kg
RBCfish	3.3E-03	1.2E-02	6.3E-02	4.0E-02	3.3E-03	1.2E-02	6.3E-02	4.0E-02
PRGsed	**3.8E-03**	**1.7E-02**	**1.3E-01**	**7.6E-02**	**2.1E-03**	**9.4E-03**	**7.1E-02**	**4.1E-02**

Equations

Risk-Based Concentrations in Fish Fillet

$$\text{RBCfish} = \frac{\text{TCR * AT}}{\text{CF * IFS * FI * CL * EF * SFo}}$$

where:

IFSadj = (ED*IR)/BW + (ED*IR/BW
IFSadj = 1.11E+04

$$\text{RBCfish} = \frac{\text{TCR * BW * AT}}{\text{CF * IR * FI * CL * EF * ED * SFo}}$$

$$\text{RBCfish} = \frac{\text{THQ * BW * AT * RfD}}{\text{CF * IR * FI * CL * EF * ED}}$$

PRGs in Sediment

Predatory Fish (PF)
PRGsed = 3.580*exp(ln(RBCfish)/0.833)

Bottom-Feeding Fish (BFF)
PRGsed = 1.955*exp(ln(RBCfish)/0.833)

Parameter Values

Symbol	Units	Angler				
		Adult risk	Child risk	Adult/Child risk	Adult hazard	Child hazard
PRGsed	mg/kg	calculated	calculated	calculated	calculated	calculated
RBCfish	mg/kg	above	above	above	above	above
TCR	unitless	1.00E-06	1.00E-06	1.00E-06	N/A	N/A
THQ	unitless	N/A	N/A	N/A	1	1
BW	kg	70	15	n/a	70	15
AT	days	25,550	25,550	25,550	10,950	2,190
CF	kg/mg	1E-06	1E-06	1E-06	1E-06	1E-06
IR	mg/day	23,200	7,750	N/A	23,200	7,750
FI	unitless	1	1	1	1	1
CL	unitless	1	1	1	1	1
EF	days/year	350	350	350	350	350
ED	years	24	6	N/A	30	6
IFSadj	mg-year/kg-day	N/A	N/A	11054	N/A	N/A
SFo	$(mg/kg\text{-}d)^{-1}$	2.0E+00	2.0E+00	2.0E+00	N/A	N/A
RfD	mg/kg-d	N/A	N/A	N/A	2.00E-05	2.00E-05
Mean Lipid (PF)	unitless	0.0116	0.0116	0.0116	0.0116	0.0116
Mean TOC (PF)	unitless	0.0513	0.0513	0.0513	0.0513	0.0513
Mean Lipid (BFF)	unitless	0.00973	0.00973	0.00973	0.00973	0.00973
Mean TOC (BFF)	unitless	0.0265	0.0265	0.0265	0.0265	0.0265

Notes:
1. For cancer risk-based PRGs, exposure was based on 6 years as child and 24 years as an adult.
N/A = Not applicable
kg = kilogram
mg = milligram

Table D-5a
CALCULATION OF ECOLOGICAL PRGs FOR TOTAL PCBs IN SEDIMENT BASED ON INVERTEBRATE AND FISH CRITICAL BODY RESIDUES
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Receptor	**Invertebrates**		**Fish**	
Toxicity Benchmark	CBR-NOAEL	CBR-LOAEL	CBR-NOAEL	CBR-LOAEL
PRGsed (mg/kg) [Equation 1]	1.9E-01	1.9E+00	N/A	N/A
PRGsed (mg/kg) [Equation 2]	N/A	N/A	6.2E-03	8.0E-02
Geometric Mean PRGsed (mg/kg)	**6.1E-01**		**2.2E-02**	

PRGsed is calculated based on both CBR-NOAEL and CBR-LOAEL and the geometric mean of the resulting PRGseds is the designated PRGsed for each receptor. An example solution for Equation 1 is provided in Attachment 1.

Calcuation of PRGsed for invertebrate and fish CBRs:

Equation 1: PRGsed for Invertebrate CBR = $\frac{\%\ TOC * CBR}{Invert\ BASF * Invert\ \%\ Lipid}$

Equation 2: PRGsed for Fish CBR = 0.719*exp(ln(CBR)/0.897)

Parameter Values

Parameter	**Symbol**	**Units**	**Invertebrates**	**Fish**	**Source**
Critical body residue - NOAEL based	CBR-NOAEL	mg/kg	0.11	0.014	RA Tables 5-24 & 5-25
Critical body residue - LOAEL based	CBR-LOAEL	mg/kg	1.1	0.14	RA Tables 5-24 & 5-25
Sediment total organic carbon content	% TOC	unitless	5.13	N/A	Page 10
Invertebrate lipid content [1]	Invert % Lipid	unitless	1.8	N/A	RA Table 5-33
Biota-sediment accumulation factor (invertebrates) [1]	Invert BSAF	unitless	1.62	N/A	RA Table 5-33

Notes:
1 = Site-specific arithmetic average of bioaccumulation study data from Bound Brook (3 samples), New Market Pond (2 samples), Ambrose Brook (1 sample), and Lake Nelson (1 sample)
LOAEL = Lowest observable adverse effects level
NOAEL = No observable adverse effects level
N/A = Not applicable
PRG = Preliminary remediation goal
RA = Risk Assessment
kg = kilogram
mg = milligram

Table D-5b
CALCULATION OF ECOLOGICAL PRGs FOR TOTAL PCBs IN SEDIMENT BASED ON CRITICAL BIRD EGG RESIDUE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Receptor	**Critical Bird Egg Residue**	
Toxicity Benchmark	CBR-NOAEL	CBR-LOAEL
PRGsed (mg/kg) [Equation 3]	1.4E-02	1.8E-01
Geometric Mean PRGsed (mg/kg)	**5.1E-02**	

PRGsed is calculated based on both CBR-NOAEL and CBR-LOAEL and the geometric mean of the resulting PRGseds is the designated PRGsed for the receptor. An example solution is provided in Attachment 1.

Calculation of PRGsed for critical bird egg residue:

Equation 3: PRGsed for critical bird egg residue = 0.719*exp(ln((CBR * Fish % Lipid)/(Bird Egg BMF * Bird Egg % Lipid))/0.897)

Parameter Values

Parameter	**Symbol**	**Units**	**Value**	**Source**
Critical body residue - NOAEL based	CBR-NOAEL	mg/kg	1.1	RA Table 5-27
Critical body residue - LOAEL based	CBR-LOAEL	mg/kg	10.9	RA Table 5-27
Fish lipid content	Fish % Lipid	unitless	3.34	Page 10
Bird egg lipid content	Bird Egg % Lipid	unitless	7.7	RA Appendix I
Bird egg biomagnification factor	Bird Egg BMF	unitless	16	RA Appendix I

Notes:
LOAEL = Lowest observable adverse effects level
NOAEL = No observable adverse effects level
PRG = Preliminary remediation goal
RA = Risk Assessment
kg = kilogram
mg = milligram

Table D-5C
CALCULATION OF ECOLOGICAL PRGs FOR TOTAL PCBs IN SEDIMENT BASED ON AVIAN WILDLIFE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Feeding Guild	**Piscivorous Bird**		**Insectivorous Bird**	
Representative Wildlife Receptor	**Belted Kingfisher**		**Red-Winged Blackbird**	
Toxicity Benchmark	TRV-NOAEL	TRV-LOAEL	TRV-NOAEL	TRV-LOAEL
PRGsed (mg/kg) [Equation 4]	1.4E+00	1.5E+01	N/A	N/A
PRGsed (mg/kg) [Equation 5]	N/A	N/A	2.4E-01	2.4E+00
Geometric Mean PRGsed (mg/kg)	**4.7E+00**		**7.7E-01**	

PRGsed is calculated based on both TRV-NOAEL and TRV-LOAEL and the geometric mean of the resulting PRGseds is the designated PRGsed for each feeding guild. Example solutions are provided in Attachment 1.

Calculation of PRGsed for each representative avian wildlife receptor:

Equation 4: PRGsed for Piscivorous Bird =

$$\frac{0.719*\exp(\ln((THQ * BW * TRV)/(IRf * PFfish))/0.897) + (THQ * BW * TRV)/}{((BSAFinvert * Invert\ \%\ Lipid)/(\%TOC) * IRf * PFinvert) + Irs}$$

Equation 5: PRGsed for Insectivorous Bird =

$$\frac{THQ * BW * TRV}{(((BSAFinvert * Invert\ \%\ Lipid)/\%\ TOC) * IRf * PFinvert) + IRsed}$$

Parameter Values

Parameter	**Symbol**	**Units**	**Representative Wildlife Receptor**		**Source**
			Belted Kingfisher	**Red-Winged Blackbird**	
Target hazard quotient	THQ	unitless	1	1	--
Body weight	BW	kg	0.15	0.053	RA Table 5-28
Toxicity reference value - NOAEL based	TRV-NOAEL	mg/kg/day	0.11	0.11	RA Table 5-30
Toxicity reference value - LOAEL based	TRV-LOAEL	mg/kg/day	1.1	1.1	RA Table 5-30
Food ingestion rate	IRf	kg/day	0.075	0.042	RA Table 5-28
Proportion of fish in diet	PFfish	unitless	0.7	N/A	RA Table 5-28
Proportion of invertebrates in diet	PFinvert	unitless	0.3	1	RA Table 5-28
Sediment ingestion rate	IRsed	kg/day	0.0004	0.0001	RA Table 5-28
Sediment total organic carbon content	% TOC	unitless	5.13	5.13	Page 10
Invertebrate lipid content [1]	Invert % Lipid	unitless	1.8	1.8	RA Table 5-33
Biota-sediment accumulation factor (invertebrates) [1]	BSAFinvert	unitless	1.62	1.62	RA Table 5-33

Notes:
1 = Site-specific arithmetic average of bioaccumulation study data from Bound Brook (3 samples), New Market Pond (2 samples), Ambrose Brook (1 sample), and Lake Nelson (1 sample)

LOAEL = Lowest observable adverse effects level
NOAEL = No observable adverse effects level
N/A = Not applicable
PRG = Preliminary remediation goal
RA = Risk Assessment
kg = kilogram
mg = milligram

Table D-5d
CALCULATION OF ECOLOGICAL PRGs FOR TOTAL PCBs IN SEDIMENT BASED ON MAMMALIAN WILDLIFE
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Feeding Guild	**Piscivorous Mammal**		**Insectivorous Mammal**		**Herbivorous Mammal**	
Representative Wildlife Receptor	**American Mink**		**Little Brown Bat**		**Muskrat**	
Toxicity Benchmark	TRV-NOAEL	TRV-LOAEL	TRV-NOAEL	TRV-LOAEL	TRV-NOAEL	TRV-LOAEL
PRGsed (mg/kg) [Equation 6]	7.6E+00	1.6E+01	N/A	N/A	N/A	N/A
PRGsed (mg/kg) [Equation 7]	N/A	N/A	6.1E-01	6.1E+00	N/A	N/A
PRGsed (mg/kg) [Equation 8]	N/A	N/A	N/A	N/A	5.6E+00	5.6E+01
Geometric Mean PRGsed (mg/kg)	**1.1E+01**		**1.9E+00**		**1.8E+01**	

PRGsed is calculated based on both TRV-NOAEL and TRV-LOAEL and the geometric mean of the resulting PRGseds is the designated PRGsed for each feeding guild. Example solutions are provided in Attachment 1.

Calculation of PRGsed for each representative mammalian wildlife receptor:

Equation 6: PRGsed for Piscivorous Mammal =

$$\frac{0.719*\exp(\ln((THQ * BW* TRV)/(IRf * PFf))/0.897)+(THQ*BW*TRV)}{(BSAFinvert * Invert\ \%\ Lipid/\%TOC*IRf * PFinvert)+Irs}$$

Equation 7: PRGsed for Insectivorous Mammal =

$$\frac{THQ * BW * TRV}{(((BSAFinvert * Invert\ \%\ Lipid)/\%\ TOC) * IRf * PFinvert) + IRs}$$

Equation 8: PRGsed for Herbivorous Mammal =

$$\frac{THQ * BW * TRV}{(BAFplant * IRf * PFplant) + IRsed}$$

Parameter Values

Parameter	**Symbol**	**Units**	**Representative Wildlife Receptor**			**Source**
			American Mink	**Little Brown Bat**	**Muskrat**	
Target hazard quotient	THQ	unitless	1	1	1	--
Body weight	BW	kg	1	0.008	1.2	RA Table 5-28
Toxicity reference value - NOAEL based	TRV-NOAEL	mg/kg/day	0.11	0.305	0.305	RA Table 5-31
Toxicity reference value - LOAEL based	TRV-LOAEL	mg/kg/day	0.23	3.05	3.05	RA Table 5-31
Food ingestion rate	IRf	kg/day	0.21	0.007	0.48	RA Table 5-28
Proportion of fish in diet	PFfish	unitless	0.88	N/A	N/A	RA Table 5-28
Proportion of invertebrates in diet	PFinvert	unitless	0.12	1	N/A	RA Table 5-28
Proportion of plants in diet	PFplant	unitless	N/A	N/A	1	RA Table 5-28
Sediment ingestion rate	IRsed	kg/day	0.001	0	0.0058	RA Table 5-28
Sediment total organic carbon content	% TOC	unitless	5.13	5.13	N/A	Page 10
Invertebrate lipid content [1]	Invert % Lipid	unitless	1.8	1.8	N/A	RA Table 5-33
Biota-sediment accumulation factor (invertebrates) [1]	BSAFinvert	unitless	1.62	1.62	N/A	RA Table 5-33
Bioaccumulation factor (plant)	BAFplant	unitless	N/A	N/A	0.124	RA Table 5-23

Notes:
1 = Site-specific arithmetic average of bioaccumulation study data from Bound Brook (3 samples), New Market Pond (2 samples), Ambrose Brook (1 sample), and Lake Nelson (1 sample)
LOAEL = Lowest observable adverse effects level
NOAEL = No observable adverse effects level
N/A = Not applicable
PRG = Preliminary remediation goal
RA = Risk Assessment
kg = kilogram
mg = milligram

Table D-6
TOTAL PCBs IN PUMPKINSEED SUNFISH FILLET, SURFACE SEDIMENT, AND BE-7 BEARING SURFACE SEDIMENT SUMMARY STATISTICS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

River Mile	Pumpkinseed Sunfish Fillet (2008 data only)					Surface Sediment (0-6 inches)					Be-7 Bearing Surface Sediment				
	Number of Samples	Number of Nondetects	Mean Lipid Normalized Aroclor 1254 Concentration (mg/kg lipid)	Standard Deviation	Standard Error	Number of Samples	Number of Nondetects	Mean TOC Normalized Aroclor 1254 Concentration (mg/kg OC)	Standard Deviation	Standard Error	Number of Be-7 Samples	Number of Nondetects	Mean TOC Normalized Aroclor 1254 Concentration (mg/kg OC)	Standard Deviation	Standard Error
5.19	2	0	167	42	30	6	0	119	94	38	2	0	232	18	13
5.66	4	0	132	37	19	5	1	125	81	36	4	0	201	45	22
6.32	5	0	316	97	43	15	0	1752	2280	589	3	0	131	74	43
6.50	5	0	133	43	19	16	0	1527	2297	574	3	0	131	74	43
7.32	5	0	7.4	3.7	1.7	8	6	7.7	13	4.5	4	0	3.6	1.6	0.78

Notes:

1. Pumpkinseed sunfish fillet data were collected by the USEPA in 2008 (USEPA, 2010).
2. Surface sediment and Be-7 bearing surface sediment data were collected in 2011 during the OU4 Remedial Investigation.
3. Nondetects are equal to 1/2 detection limit.
4. Aroclor 1254 concentrations are taken as representative of Total PCB concentrations.

kg = kilogram
mg = milligram
OC = organic carbon

Table D-7
TOTAL PCBs IN WHITE SUCKER FILLET AND SURFACE SEDIMENT SUMMARY STATISTICS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

River Mile	White Sucker Fillet (2008 data only)					Surface Sediment (0-6 inches)				
	Number of Samples	Number of Nondetects	Mean Lipid Normalized Aroclor 1254 Concentration (mg/kg lipid)	Standard Deviation	Standard Error	Number of Samples	Number of Nondetects	Mean TOC Normalized Aroclor 1254 Concentration (mg/kg OC)	Standard Deviation	Standard Error
3.71	3	0	340	288	166	7	0	81	39	15
5.19	8	0	193	101	36	6	0	119	94	38
5.66	8	0	280	108	38	5	1	125	81	36
6.32	8	0	1,325	754	266	15	0	1,752	2,280	589
6.50	6	0	1,068	227	80	16	0	1,527	2,297	574
7.32	6	0	9.2	1.4	0.57	8	6	7.7	13	4.5

Notes:

1. White sucker fillet data were collected by the USEPA in 2008 (USEPA, 2010).
2. Surface sediment data were collected in 2011 during the OU4 Remedial Investigation.
3. Nondetects are equal to 1/2 detection limit.
4. Aroclor 1254 concentrations are taken as representative of Total PCB concentrations.

kg = kilogram

mg = milligram

OC = organic carbon

Table D-8
TOTAL PCBs IN PUMKINSEED SUNFISH WHOLE BODY, SURFACE SEDIMENT, AND BE-7 BEARING SURFACE SEDIMENT DATA SUMMARY STATISTICS
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

River Mile	Pumpkinseed Sunfish Whole Body (2008 data only)					Surface Sediment (0-6 inches)					Be-7 Bearing Surface Sediment				
	Number of Samples	Number of Nondetects	Mean Lipid Normalized Aroclor 1254 Concentration (mg/kg lipid)	Standard Deviation	Standard Error	Number of Samples	Number of Nondetects	Mean TOC Normalized Aroclor 1254 Concentration (mg/kg OC)	Standard Deviation	Standard Error	Number of Samples	Number of Nondetects	Mean TOC Normalized Aroclor 1254 Concentration (mg/kg OC)	Standard Deviation	Standard Error
5.19	2	0	238	103	73	6	0	119	94	38	2	0	232	18	13
5.66	4	0	185	75	37	5	1	125	81	36	4	0	201	45	22
6.32	5	0	560	137	61	15	0	1752	2280	589	3	0	131	74	43
6.50	5	0	210	75	33	16	0	1527	2297	574	3	0	131	74	43
7.86	5	0	9.2	5.4	2.4	2	1	1.2	1.4	0.98	4	0	3.6	1.6	0.78

Notes:
1. Pumpkinseed sunfish whole body data were collected by the USEPA in 2008 (USEPA, 2010).
2. Surface sediment and Be-7 bearing surface sediment data were collected in 2011 during the OU4 Remedial Investigation.
3. Nondetects are equal to 1/2 detection limit.
4. Aroclor 1254 concentrations are taken as representative of Total PCB concentrations.

kg = kilogram
mg = milligram
OC = organic carbon

Table D-9
SITE-SPECIFIC, RISK-BASED PRGs FOR TOTAL PCBs IN FLOODPLAIN SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Basis	PRG (mg/kg, dw)
Soil Screening Benchmark - Birds & Mammals [3]	3.3E-04
Human/Direct Contact - 10^{-6} Cancer Risk (Resident - adult/child) [4, 5]	2.2E-01
Insectivorous Bird TRV	2.7E-01
Human/Direct Contact - Non-cancer Hazard (Resident - child) [5]	1.1E+00
Insectivorous Mammal TRV	1.3E+00
Reference Area Floodplain Soil [6]	1.6E+00
Human/Direct Contact - 10^{-5} Cancer Risk (Resident - adult/child) [4, 5]	2.2E+00
Human/Direct Contact - Non-cancer Hazard (Resident - child; EF = 150 days/year) [7, 5]	2.6E+00
Human/Direct Contact - Non-cancer Hazard (C/I worker - adult)	1.8E+01
Human/Direct Contact - Non-cancer Hazard (R/S/A - adolescent)	2.1E+01
Human/Direct Contact - 10^{-4} Cancer Risk (Resident - adult/child) [4, 5]	2.2E+01
Soil Screening Benchmark - Plants & Invertebrates [8]	4.0E+01

Notes:

1. For direct contact by Recreationist/Sportsman/Angler (R/S/A) and Resident, the lowest PRG for the different populations ages evaluated in the forward risk assessment are presented.

2. While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario evaluated in the Risk Assessment, and included herein, is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

3. USEPA Region 5 Ecological Screening Levels for soil where protective of birds and/or mammals (accessed online at: http://www.epa.gov/reg5rcra/ca/edql.htm).

4. For cancer risk-based PRGs, exposure was based on 6 years as child and 24 years as an adult.

5. The forward risk assessment for these receptors evaluated exposure to all soil.

6. Highest reference area floodplain soil concentration for Ambrose Brook (2.9E-02 to 1.59E+00 mg/kg).

7. PRG based on an exposure frequency (EF) of 150 days/year based on 5 days/week for 10 weeks during the summer and 2 days/week for 40 weeks during the rest of the year.

8. NJDEP Site Remediation Program Ecological Screening Criteria for soil where protective of plants and/or invertebrates (accessed online at: http://www.nj.gov/dep/srp/guuidance/ecoscreening/.

kg = kilogram
mg = milligram
dw = dry weight
C/I = Commercial/Industrial Worker

Table D-10
HUMAN HEALTH/DIRECT CONTACT PRGs FOR TOTAL PCBs IN FLOODPLAIN SURFACE SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

PRG	Non-cancer THQ = 1				10^{-6} Cancer Risk	
	Surface Soil	Surface Soil	All Soil		All Soil	
	Recreationist/ Sportsman/Angler	Commercial/ Industrial Worker	Resident		Resident	
	Adolescent mg/kg	Adult mg/kg	Adult mg/kg	Child mg/kg	Adult/Child [1] mg/kg	Child mg/kg
PRG-ing	3.6E+01	2.6E+01	1.5E+01	1.6E+00	3.2E-01	4.6E-01
PRG-derm	5.1E+01	6.1E+01	2.6E+01	4.0E+00	7.2E-01	1.2E+00
PRG-inh	--	--	--	--	3.4E+04	1.7E+05
PRG-total	**2.1E+01**	**1.8E+01**	**9.4E+00**	**1.1E+00**	**2.2E-01**	**3.3E-01**

Equations

Non-cancer Hazard

$$\text{PRG-ing} = \frac{\text{THQ x ATnc x BW x RfD}}{\text{EF x ED x IR x CF1}}$$

$$\text{PRG-derm} = \frac{\text{THQ x ATnc x BW x RfD}}{\text{EF x ED x EV x SA x AF x ABS x CF1}}$$

$$\text{PRG-inh} = \frac{\text{THQ x ATnc-inh x RfC x PEF}}{\text{EF x ED x ET}}$$

$$\text{PRG-total} = \frac{1}{\text{1 /SL-ing + 1/SL-derm + 1/SL-inh}}$$

Cancer Risk

$$\text{PRG-ing} = \frac{\text{TR x ATc x BW}}{\text{CSF x EF x ED x IR x CF1}}$$

$$\text{PRG-derm} = \frac{\text{TR x ATc x BW}}{\text{CSF x EF x ED x EV x SA x AF x ABS x CF1}}$$

$$\text{PRG-inh} = \frac{\text{TR x ATc-inh x PEF}}{\text{IUR x CF2 x EF x ED x ET}}$$

$$\text{PRG-total} = \frac{1}{\text{1 /SL-ing + 1/SL-derm + 1/SL-inh}}$$

Parameter Values

Symbol	Units	Recreationist/ Sportsman/Angler Adolescent hazard	Commercial/ Industrial Worker Adult hazard	Resident Adult hazard	Resident Child hazard	Resident Adult/Child risk	Resident Child risk
THQ	unitless	1	1	1	1	N/A	N/A
TCR	unitless	N/A	N/A	N/A	N/A	1E-06	1E-06
ATnc	days	4,380	365	10,950	2,190	N/A	N/A
ATnc-inh	hours	105,120	1,968	262,800	52,560	N/A	N/A
ATc	days	N/A	NA	N/A	N/A	25,550	25,550
ATc-inh	hours	N/A	N/A	N/A	N/A	613,200	613,200
BW	kg	49	70	70	15	N/A	15
RfD	mg/kg-d	2E-05	2E-05	2E-05	2E-05	N/A	N/A
RfC	mg/m^3	NA	NA	NA	NA	N/A	N/A
CSF	$(mg/kg\text{-}d)^{-1}$	N/A	N/A	N/A	N/A	2E+00	2E+00
IUR	$(\mu g/m^3)^{-1}$	N/A	N/A	N/A	N/A	1E-04	1E-04
IR	mg/day	200	330	100	200	N/A	200
IRadj	mg-year/kg-day	N/A	N/A	N/A	N/A	114.3	N/A
EF	days/year	50	60	350	350	350	350
EF-inh	days/week	N/A	5	N/A	N/A	N/A	N/A
ED	years	12	1	30	6	30	6
ED-inh	weeks	n/a	12	n/a	n/a	n/a	n/a
ET	hours/day	2	8	24	24	24	24
EV	events/day	1	1	1	1	1	1
SA	cm^2	5,000	3,300	5,700	2,800	N/A	2,800
AF	mg/cm^2-event	0.2	0.3	0.07	0.2	N/A	0.2
DFSadj	mg-year/kg-day	N/A	N/A	N/A	N/A	360.8	N/A
ABS	unitless	0.14	0.14	0.14	0.14	0.14	0.14
PEF	m^3/kg	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09
CF1	kg/mg	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
CF2	μg/mg	NA	NA	NA	NA	1E+03	1E+03

Notes:
1. For cancer risk-based PRGs, exposure was based on 6 years as child and 24 years as an adult.
NA = Not available
N/A = Not applicable
kg = kilogram
mg = milligram
μg = microgram
m = meter
cm = centimeter

Table D-11
CALCULATION OF ECOLOGICAL PRGs FOR TOTAL PCBs IN FLOODPLAIN SURFACE SOIL
Cornell-Dubilier Electronics Superfund Site
Feasibility Study

Feeding Guild	**Insectivorous Bird**		**Insectivorous Mammal**	
Representative Wildlife Receptor	**American Robin**		**Short-tailed Shrew**	
Toxicity Benchmark	TRV-NOAEL	TRV-LOAEL	TRV-NOAEL	TRV-LOAEL
PRGsoil (mg/kg) [Equation 9]	8.5E-02	8.5E-01	4.0E-01	4.0E+00
Geometric Mean PRGsed (mg/kg)	2.7E-01		1.3E+00	

PRGsoil is calculated based on both TRV-NOAEL and TRV-LOAEL and the geometric mean of the resulting PRGsoils is the designated PRGsoil for each feeding guild. An example solution is provided in Attachment 1.

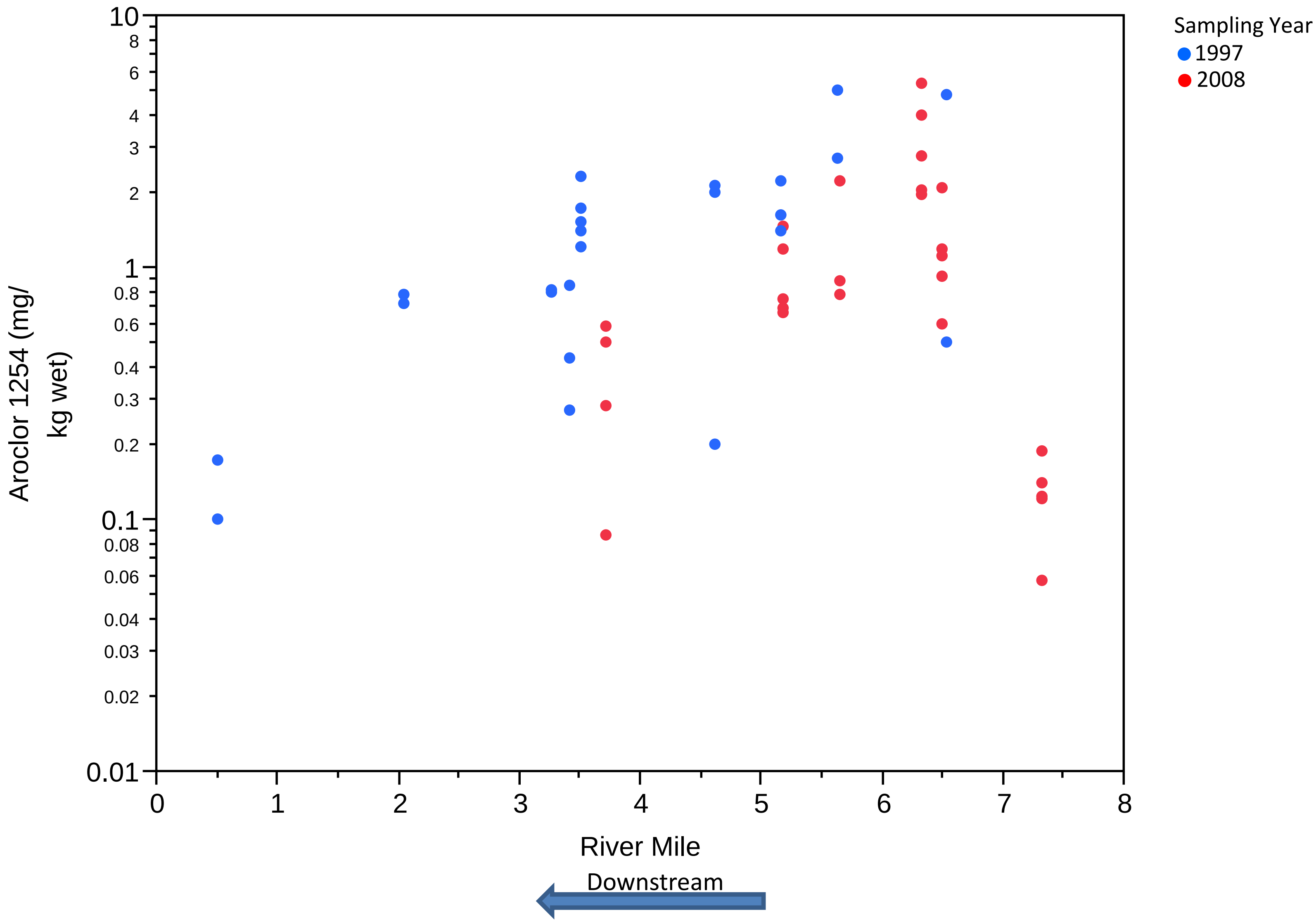
Calculation of PRGsoil for each representative wildlife receptor:

Equation 9: $$PRGsoil = \frac{THQ * BW * TRV}{(BAFinvert * IRf * PFinvert) + IRs}$$

Parameter Values

Parameter	**Symbol**	**Units**	**Representative Wildlife Receptor**		**Source**
			American Robin	**Short-tailed Shrew**	
Target hazard quotient	THQ	unitless	1	1	--
Body weight	BW	kg	0.081	0.0157	RA Table 5-28
Toxicity reference value - NOAEL based	TRV-NOAEL	mg/kg/day	0.11	0.305	RA Tables 5-30 & 31
Toxicity reference value - LOAEL based	TRV-LOAEL	mg/kg/day	1.1	3.05	RA Tables 5-30 & 31
Food ingestion rate	IRf	kg/day	0.098	0.011	RA Table 5-28
Proportion of invertebrates in diet	PFinvert	unitless	1	1	RA Table 5-28
Soil ingestion rate	IRs	kg/day	0.002	0.0003	RA Table 5-28
Bioaccumulation factor (invertebrates) [1]	BAFinvert	unitless	1.05	1.05	RA Table 5-22

Notes:
1 = Site-specific soil-to-earthworm BAF calculated as the arithmetic average BAF of the three bioaccumulation study samples from Bound Brook
LOAEL = Lowest observable adverse effects level
NOAEL = No observable adverse effects level
PRG = Preliminary remediation goal
RA = Risk Assessment
kg = kilogram
mg = milligram



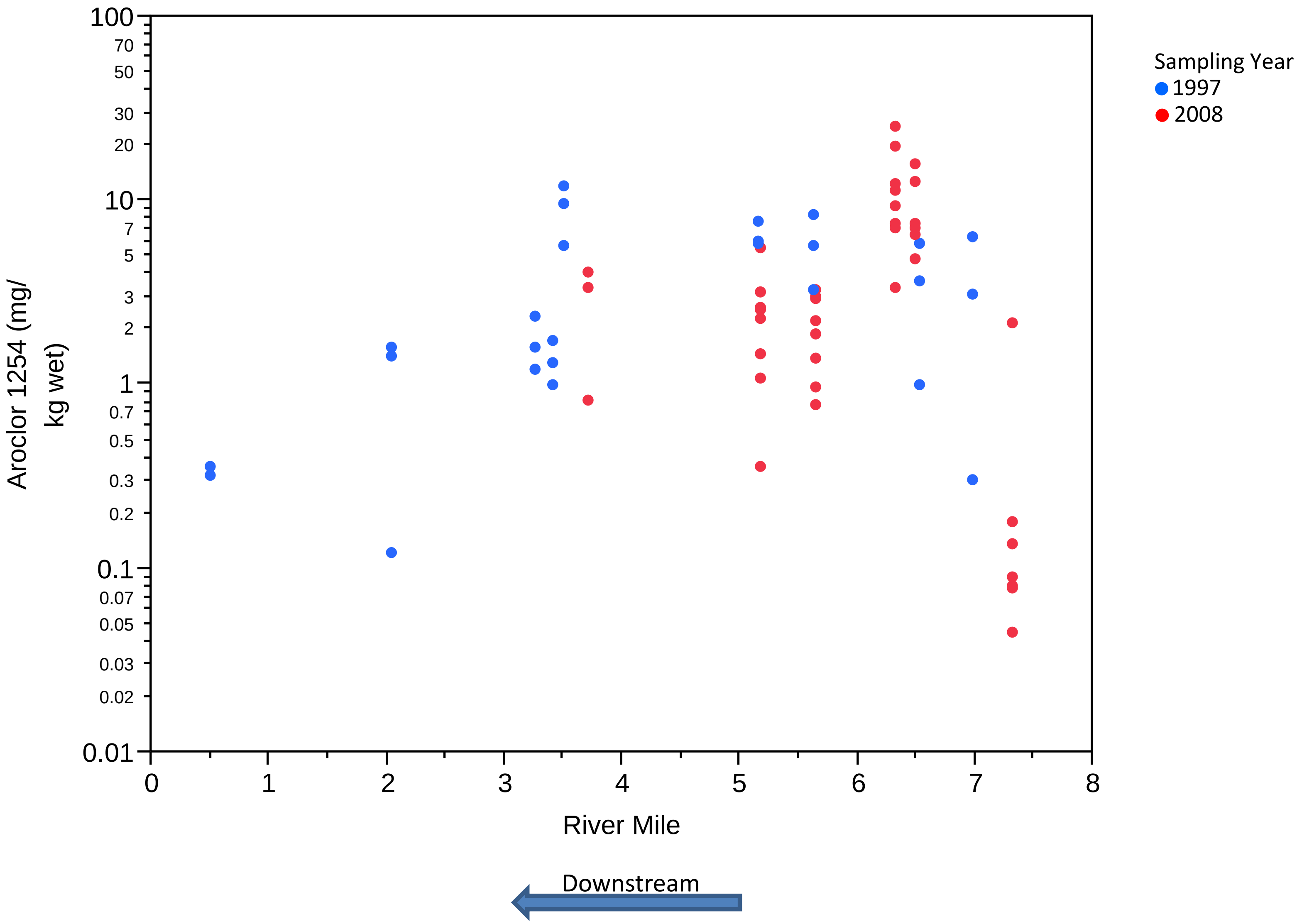
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

Pumpkinseed Sunfish Fillet –
Aroclor 1254 Concentration vs. River Mile

Bound Brook OU4 RI/FS

2014

FIGURE D-1



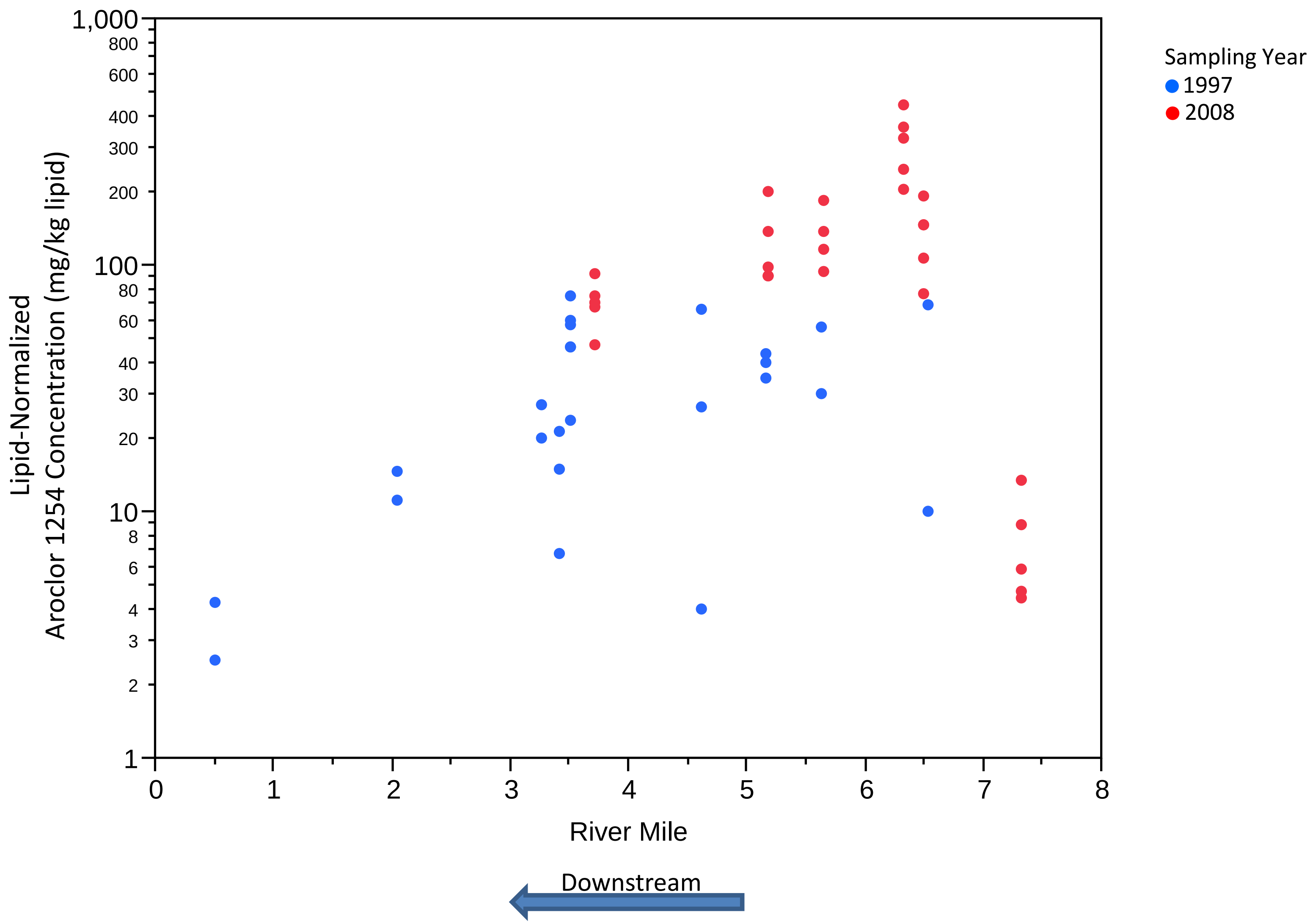
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

White Sucker Fillet –
Aroclor 1254 Concentration vs. River Mile

Bound Brook OU4 RI/FS

2014

FIGURE D-2

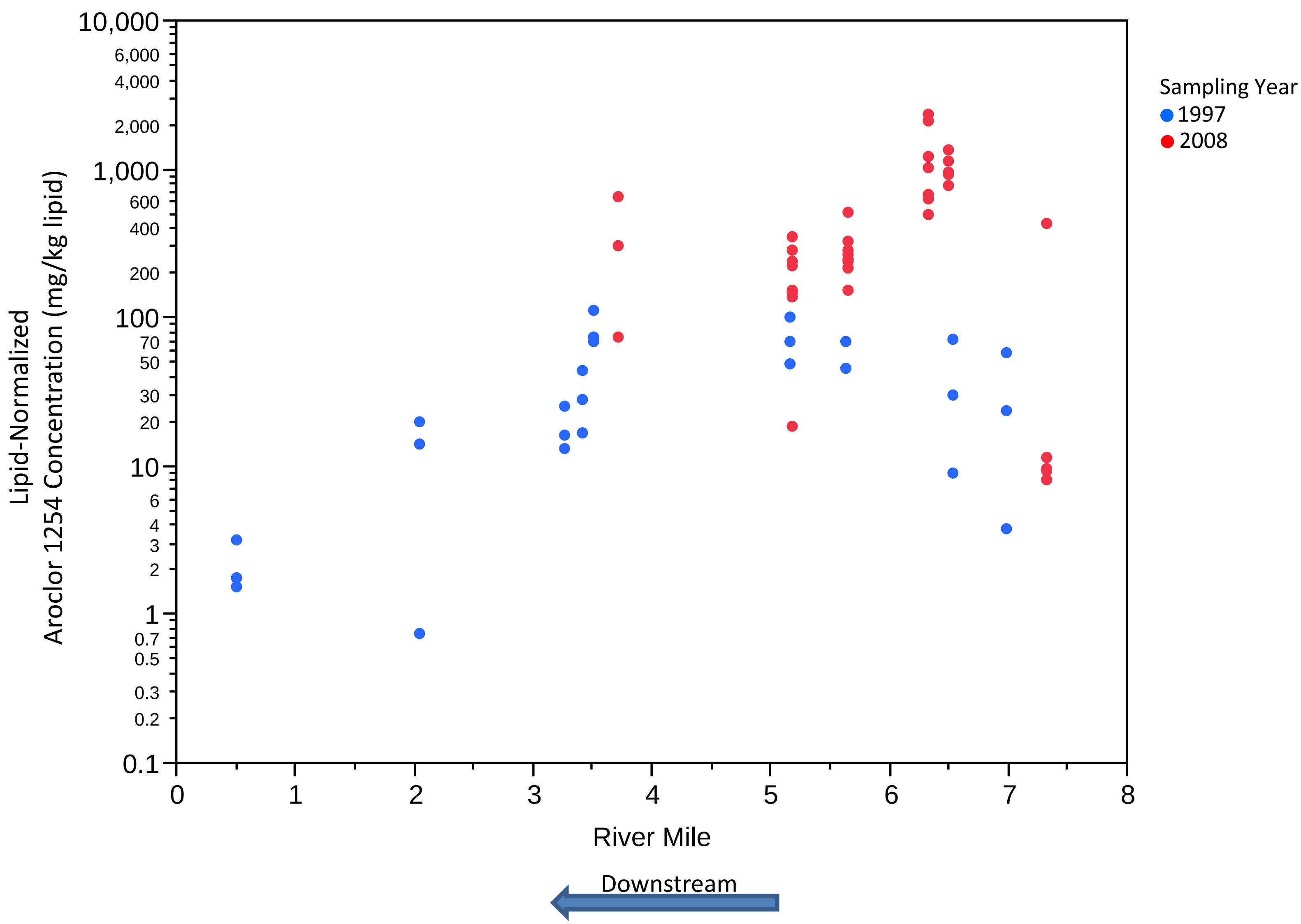


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

Pumpkinseed Sunfish Fillet –
Lipid-Normalized Aroclor 1254 Concentration
vs. River Mile
Bound Brook OU4 RI/FS

2014

FIGURE D-3

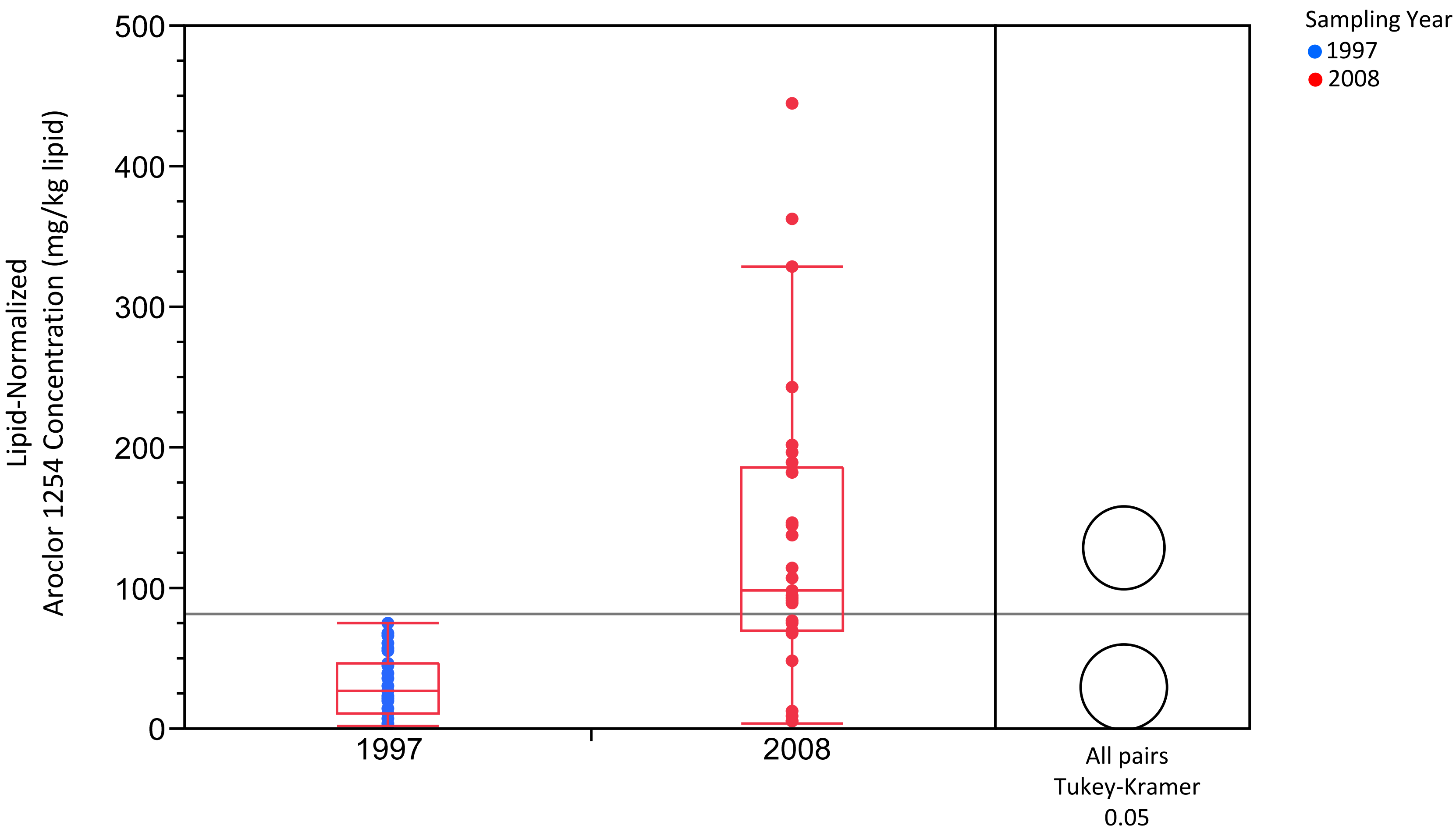


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

White Sucker Fillet –
Lipid-Normalized Aroclor 1254 Concentration vs. River Mile
Bound Brook OU4 RI/FS

2014

FIGURE D-4



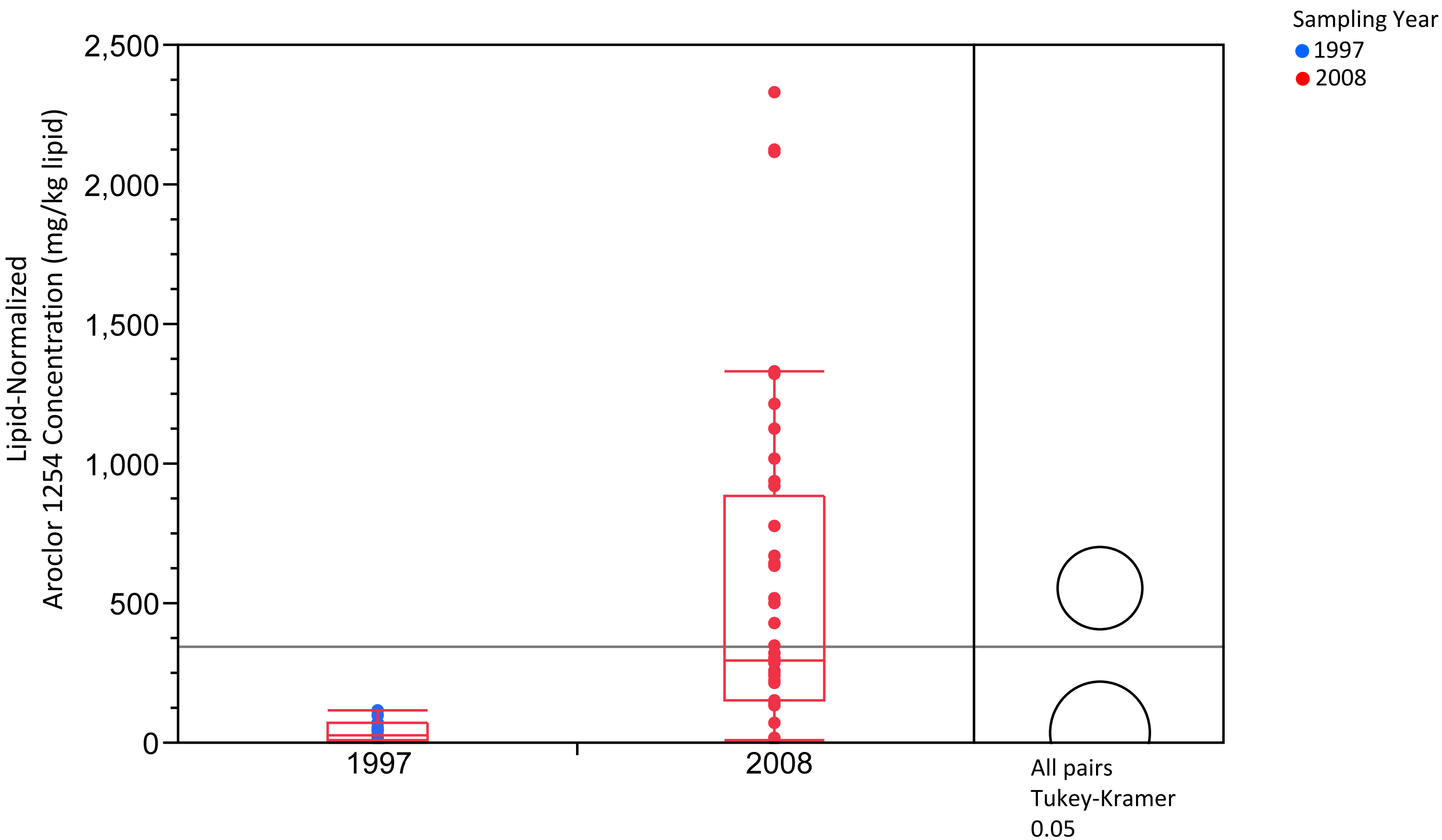
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

Pumpkinseed Sunfish Fillet – 1997 vs. 2008 Lipid-Normalized Aroclor 1254 Concentration

Bound Brook OU4 RI/FS

2014

FIGURE D-5

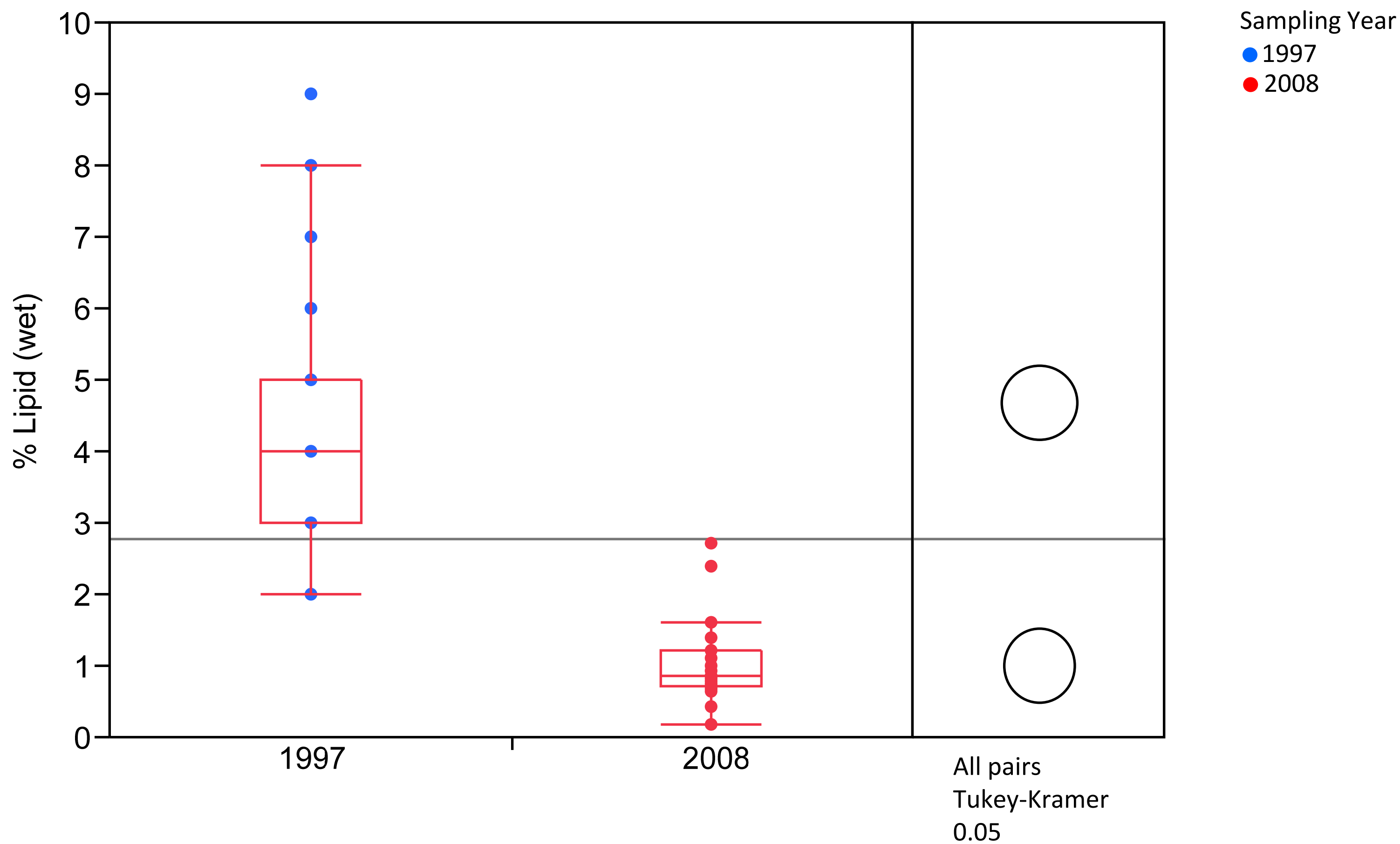


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

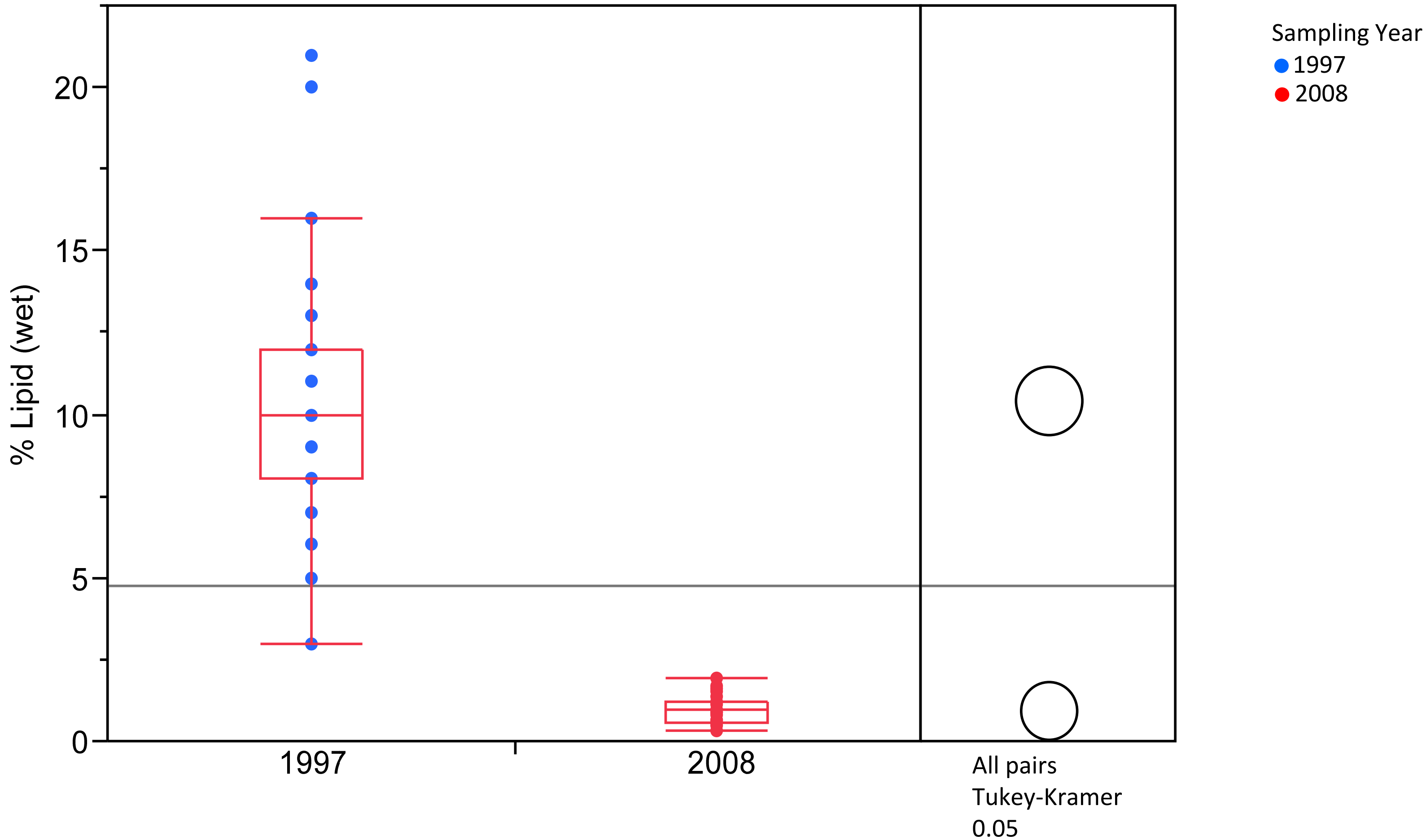
White Sucker Fillet –
1997 vs. 2008 Lipid-Normalized Aroclor 1254 Concentration
Bound Brook OU4 RI/FS

2014

FIGURE D-6



	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – 1997 vs. 2008 % Lipid Data** *Bound Brook OU4 RI/FS*	2014 FIGURE D-7



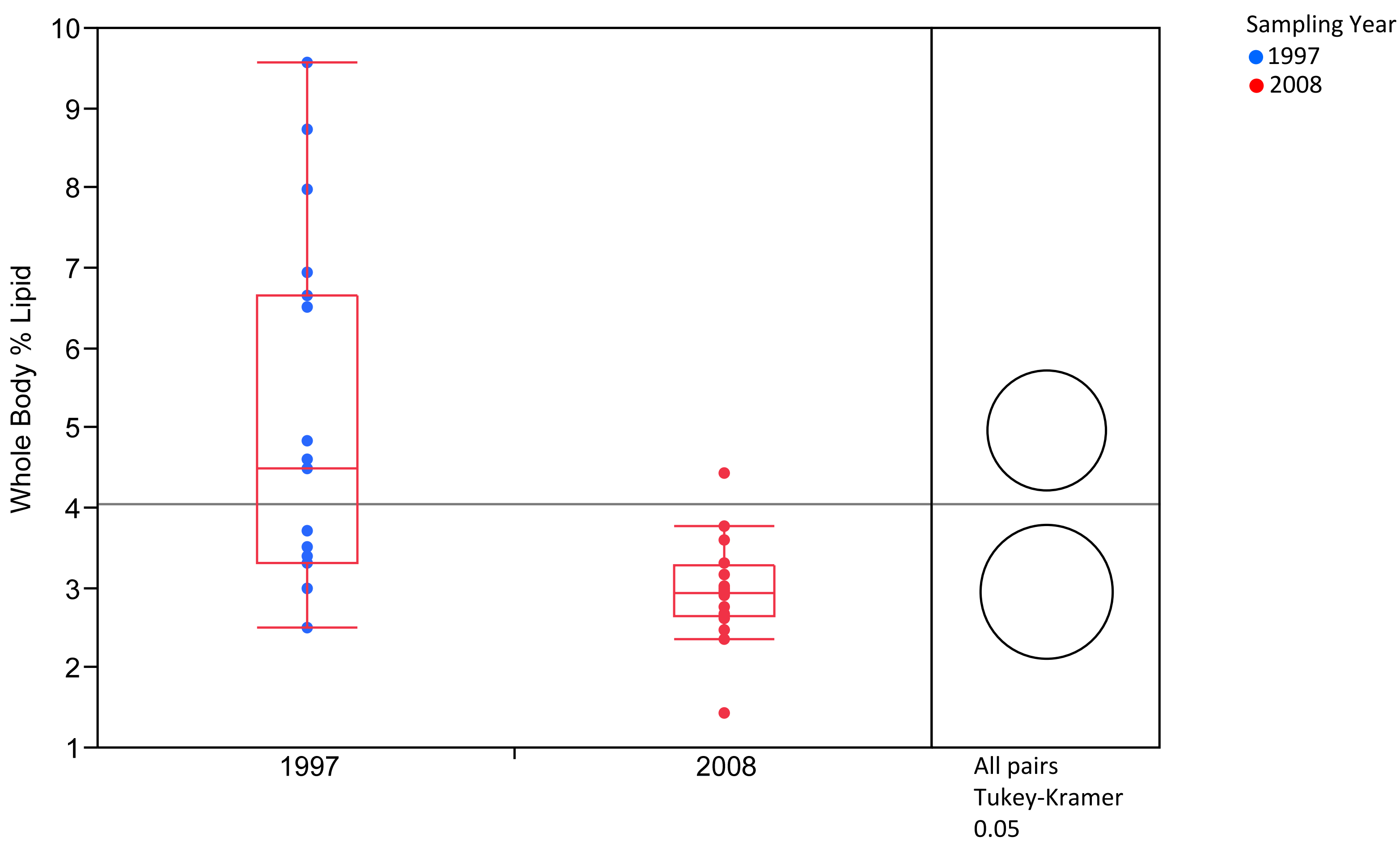
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

White Sucker Fillet –
1997 vs. 2008 % Lipid Data

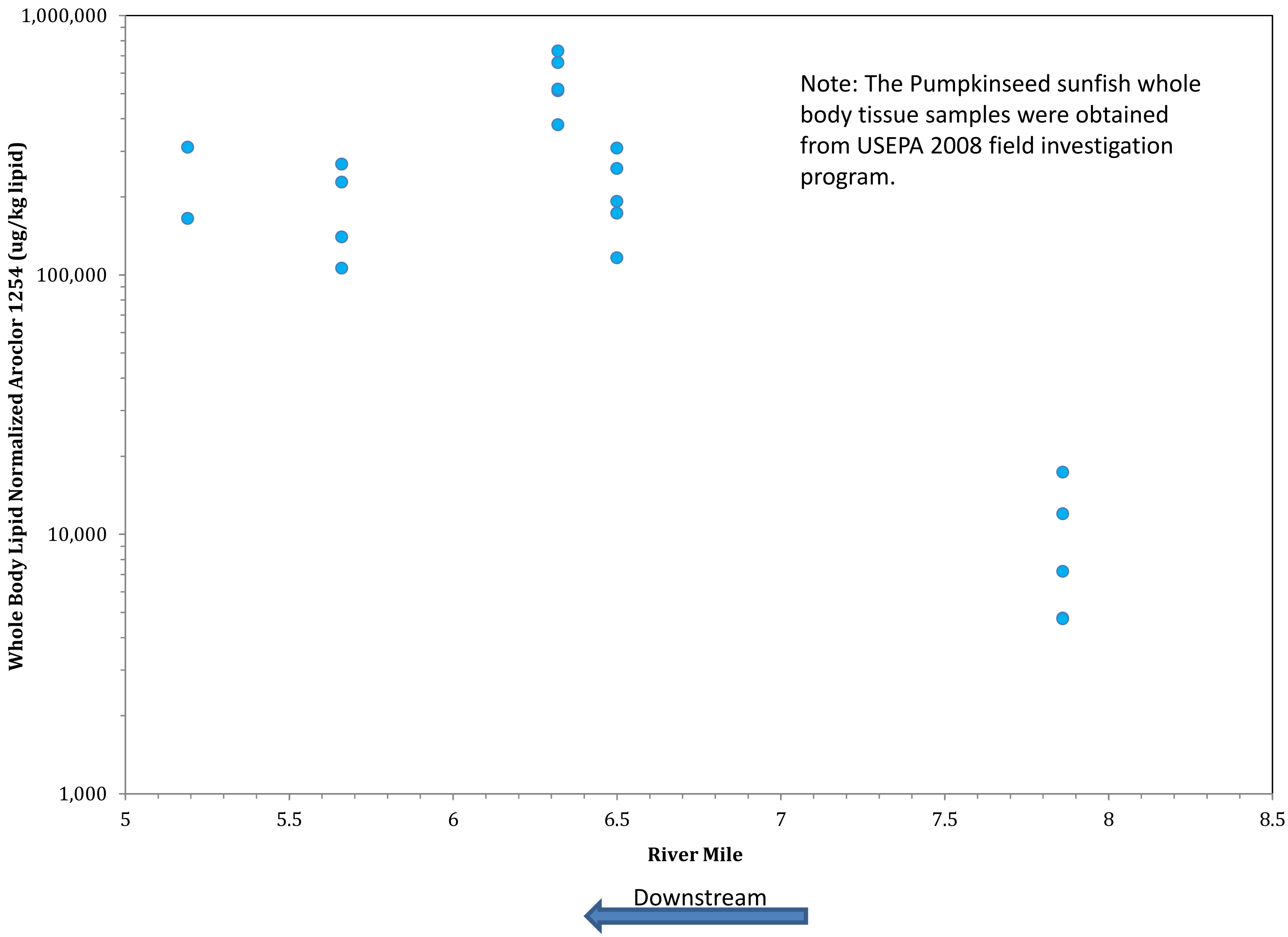
Bound Brook OU4 RI/FS

2014

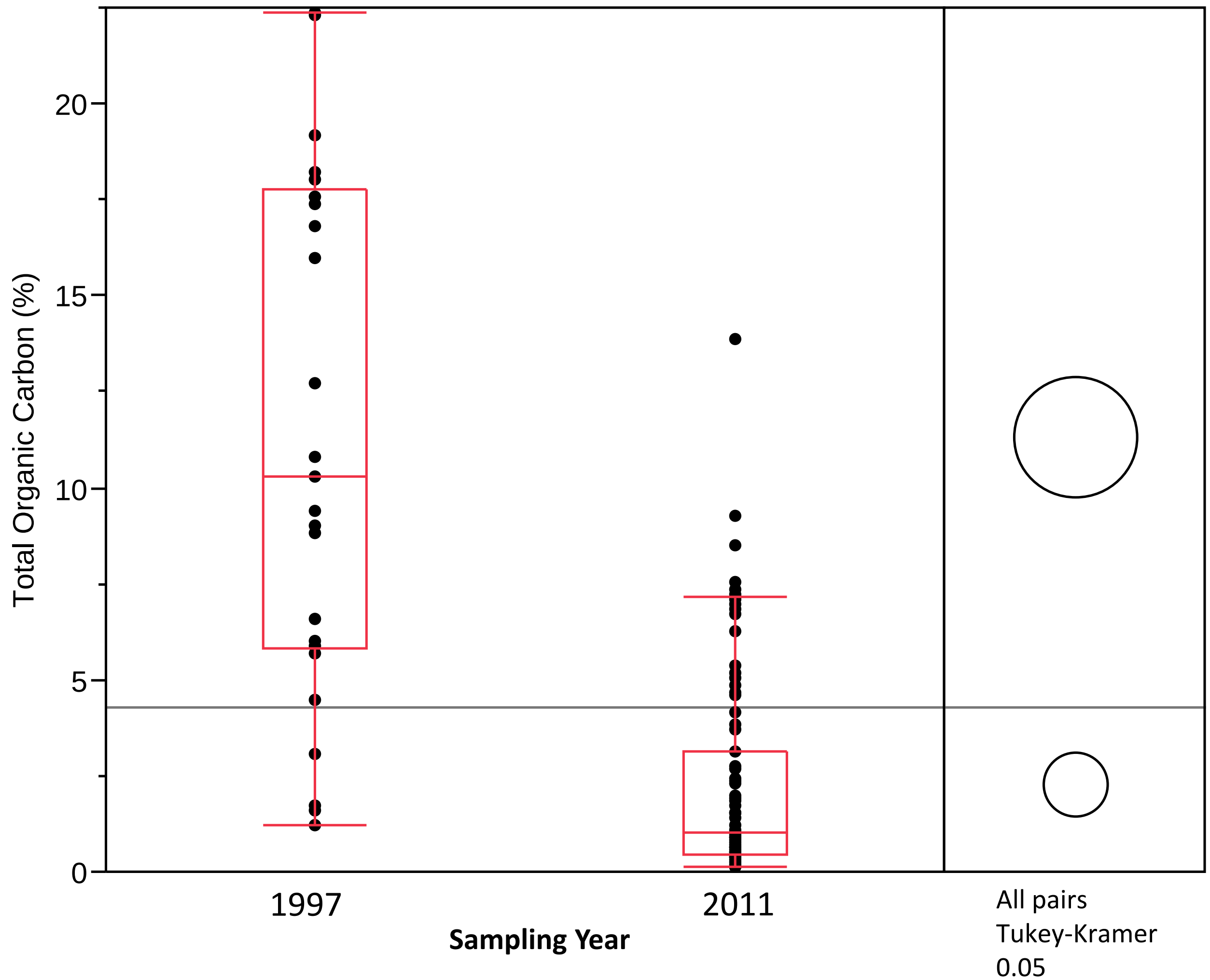
FIGURE D-8



	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – 1997 vs. 2008 % Lipid Data** *Bound Brook OU4 RI/FS*	2014 FIGURE D-9



	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – Lipid-Normalized Aroclor 1254 Concentration vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-10



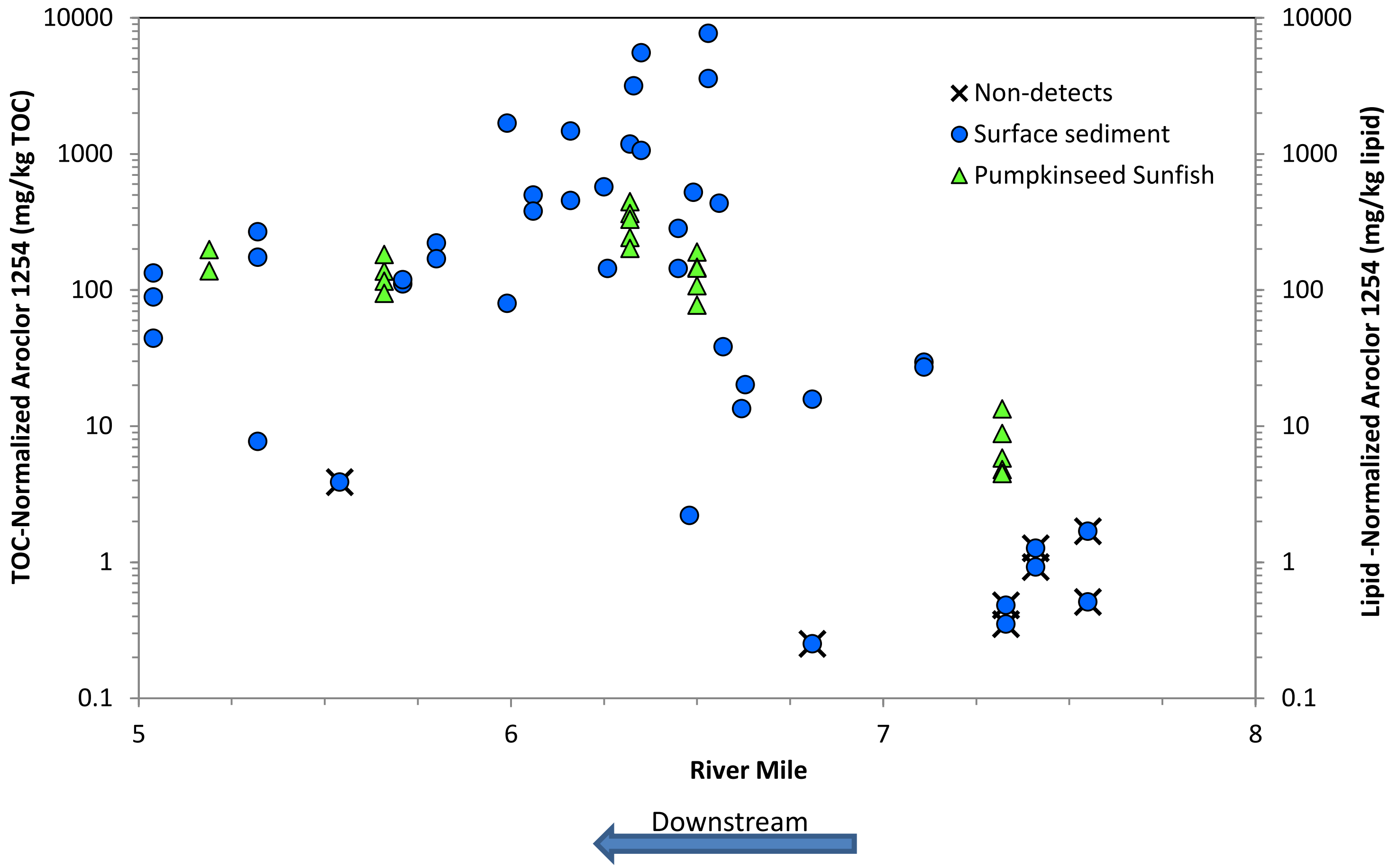
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, NJ

Surface Sediment –
1997 vs. 2011 Total Organic Carbon Data

Bound Brook OU4 RI/FS

2014

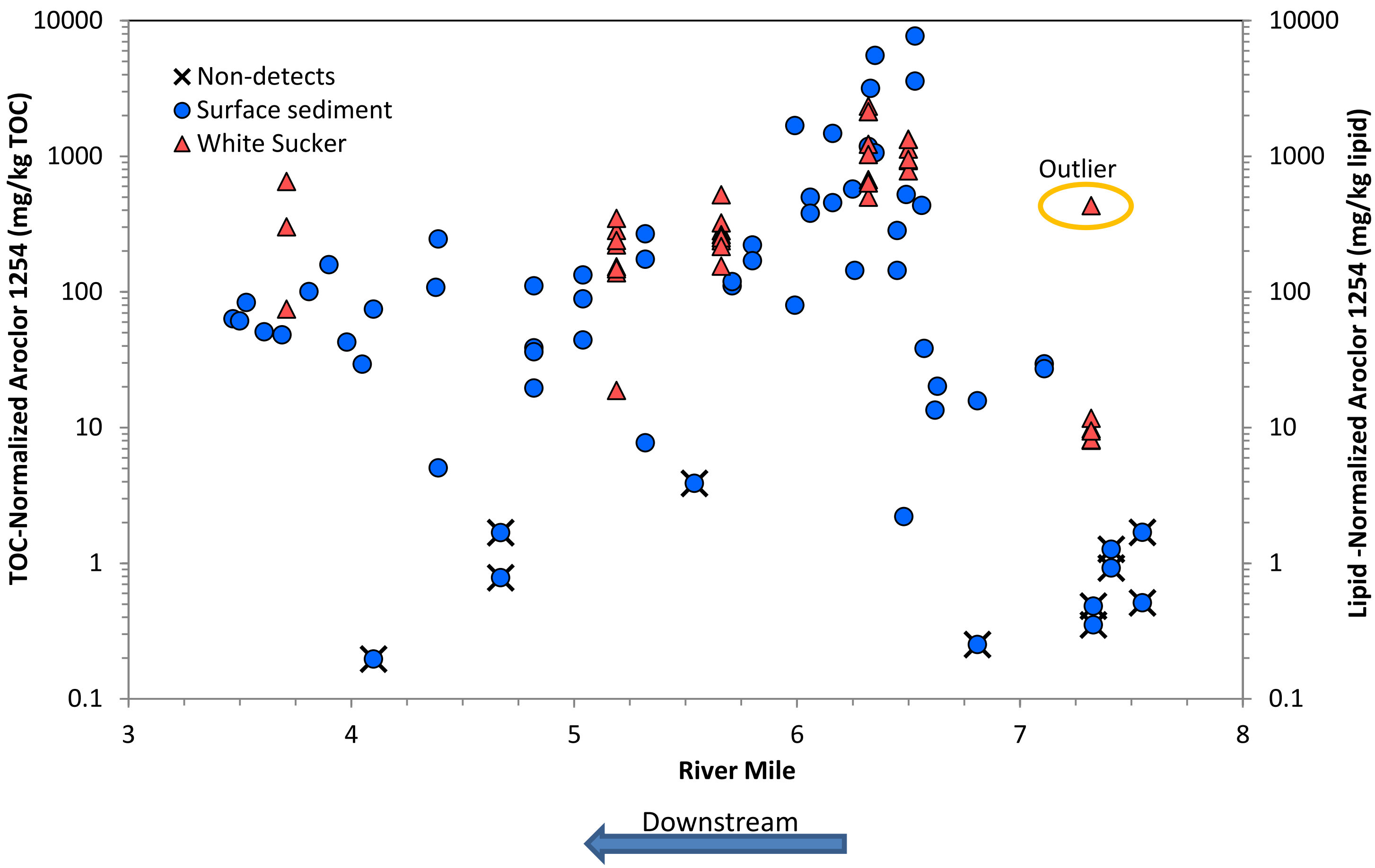
FIGURE D-11



Notes:

1. Surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. Pumpkinseed sunfish tissue samples were obtained from USEPA 2008 field investigation program.
3. Non-detects were presented as half the method detection limit.
4. Surface sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles about each tissue sampling location.

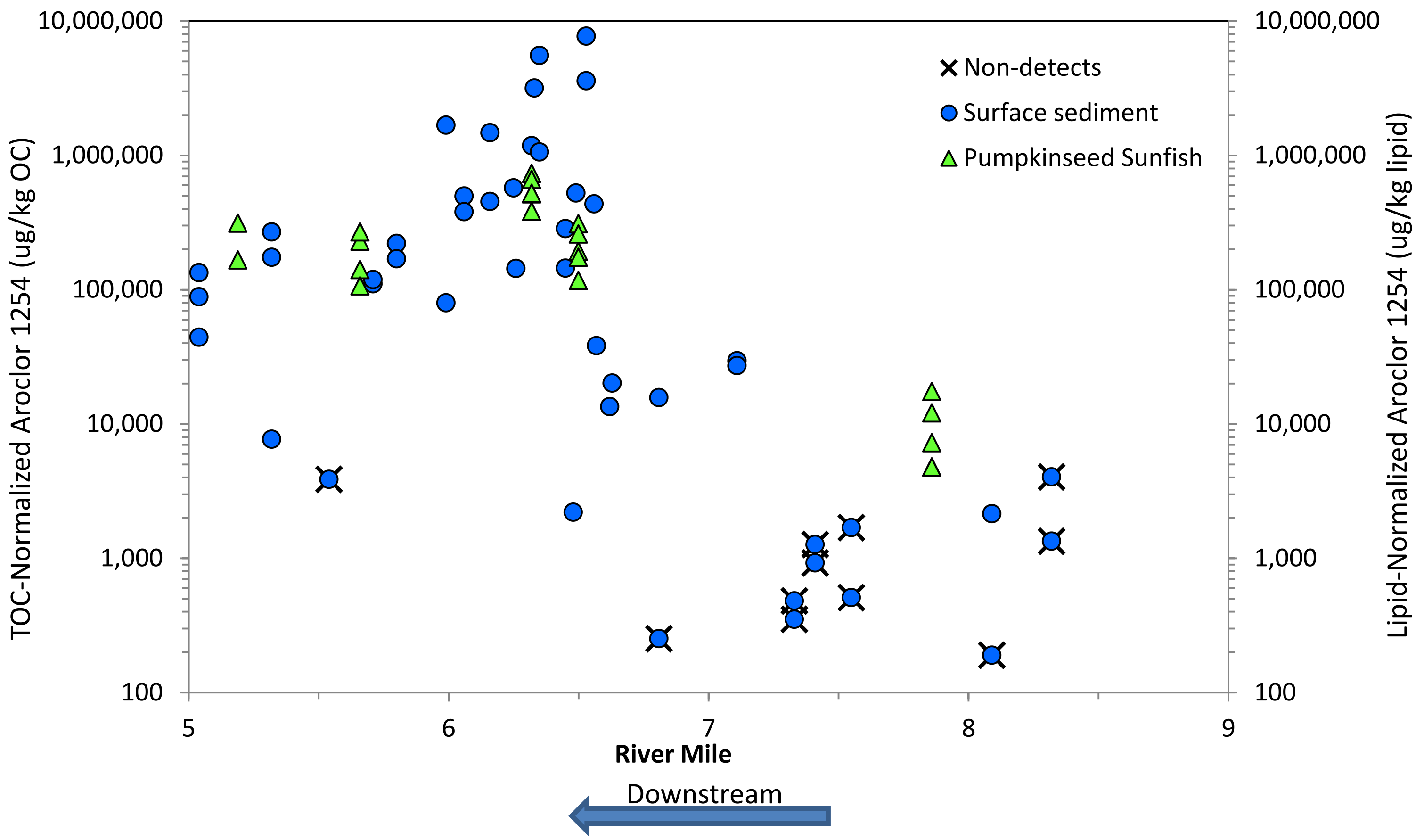
	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – TOC-Normalized Sediment and Lipid-Normalized Aroclor 1254 Concentrations vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-12



Notes:

1. Surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. White sucker tissue samples were obtained from USEPA 2008 field investigation program.
3. Non-detects were presented as half the method detection limit.
4. Surface sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles about each tissue sampling location.

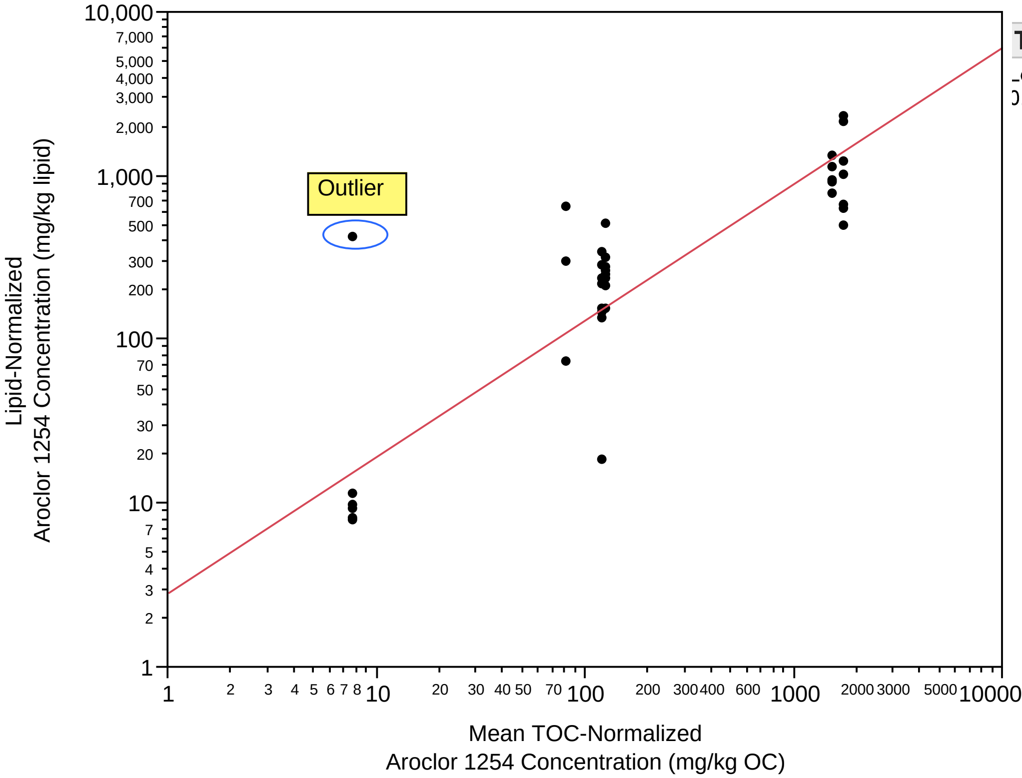
	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**White Sucker Fillet – TOC-Normalized Sediment and Lipid-Normalized Aroclor 1254 Concentrations vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-13



Notes:

1. Surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. Pumpkinseed sunfish tissue samples were obtained from USEPA 2008 field investigation program.
3. Non-detects were presented as half the method detection limit.
4. Surface sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles about each tissue sampling location.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – TOC-Normalized Sediment and Lipid-Normalized Aroclor 1254 Concentrations vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-14



Transformed Fit Log to Log

Log(Lipid Normalized A1254 (mg/kg)) = 1.0486669 + 0.8331852*Log(0.25 Mean Sed A1254/TOC (mg/kg))

Summary of Fit

RSquare	0.832969
RSquare Adj	0.828454
Root Mean Square Error	0.705972
Mean of Response	5.45025
Observations (or Sum Wgts)	39

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	91.96170	91.9617	184.5153
Error	37	18.44065	0.4984	**Prob > F**
C. Total	38	110.40235		<.0001*

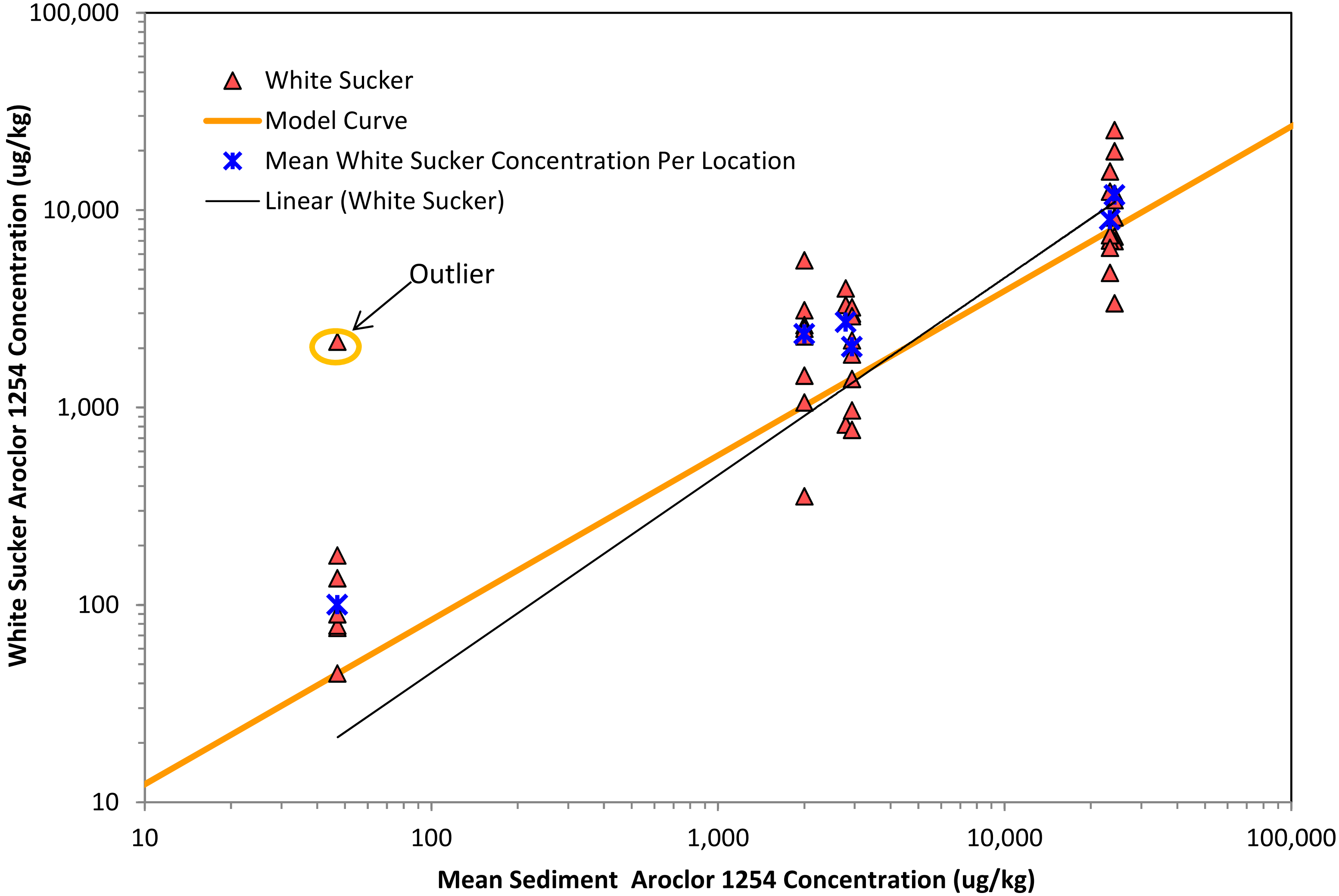
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.0486669	0.343189	3.06	0.0042*
Log(0.25 Mean Sed A1254/TOC (mg/kg))	0.8331852	0.061337	13.58	<.0001*

Notes:

1. TOC-Normalized sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles of each tissue sampling location.

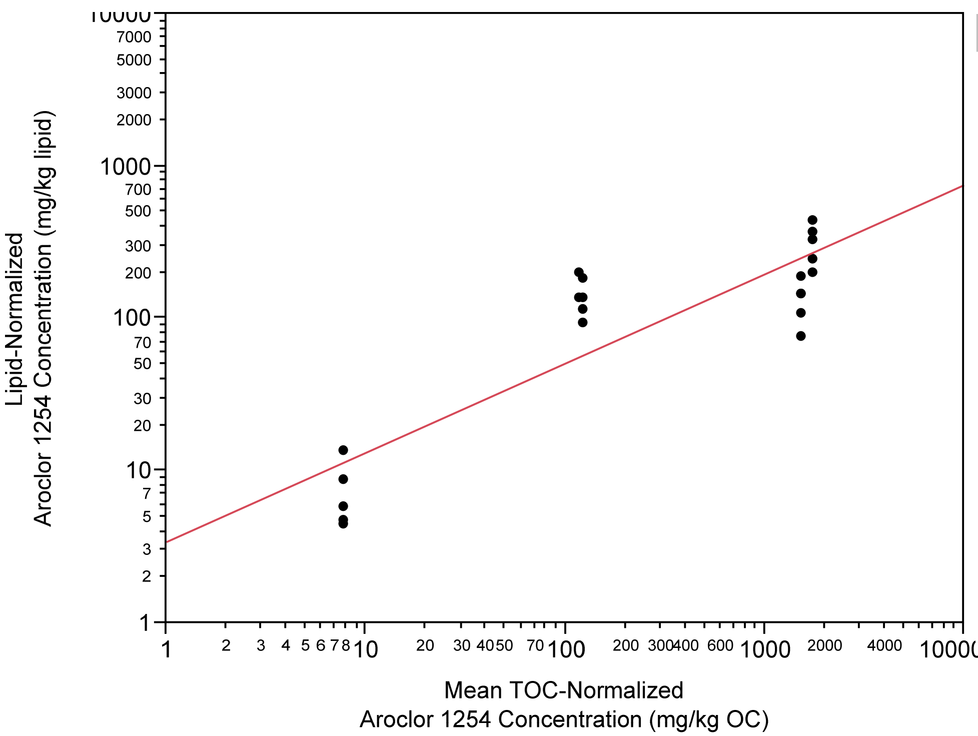
	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**White Sucker Fillet –** **Lipid-Normalized Aroclor 1254 vs. Mean TOC-Normalized Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-15



Notes:

1. Surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. White sucker tissue samples were obtained from USEPA 2008 field investigation program.
3. Surface sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles about each tissue sampling location.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**White Sucker Fillet – Tissue Aroclor 1254 Concentration vs. Mean Sediment Aroclor 1254 Concentration** *Bound Brook OU4 RI/FS*	2014 FIGURE D-16



Transformed Fit Log to Log

Log(Lipid Normalized A1254 (mg/kg)) = 1.2257132 + 0.5857694*Log(0.25 Mean Sed A1254/TOC (mg/kg))

Summary of Fit

RSquare	0.762075
RSquare Adj	0.749553
Root Mean Square Error	0.745289
Mean of Response	4.379697
Observations (or Sum Wgts)	21

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	33.803518	33.8035	60.8572
Error	19	10.553668	0.5555	**Prob > F**
C. Total	20	44.357186		<.0001*

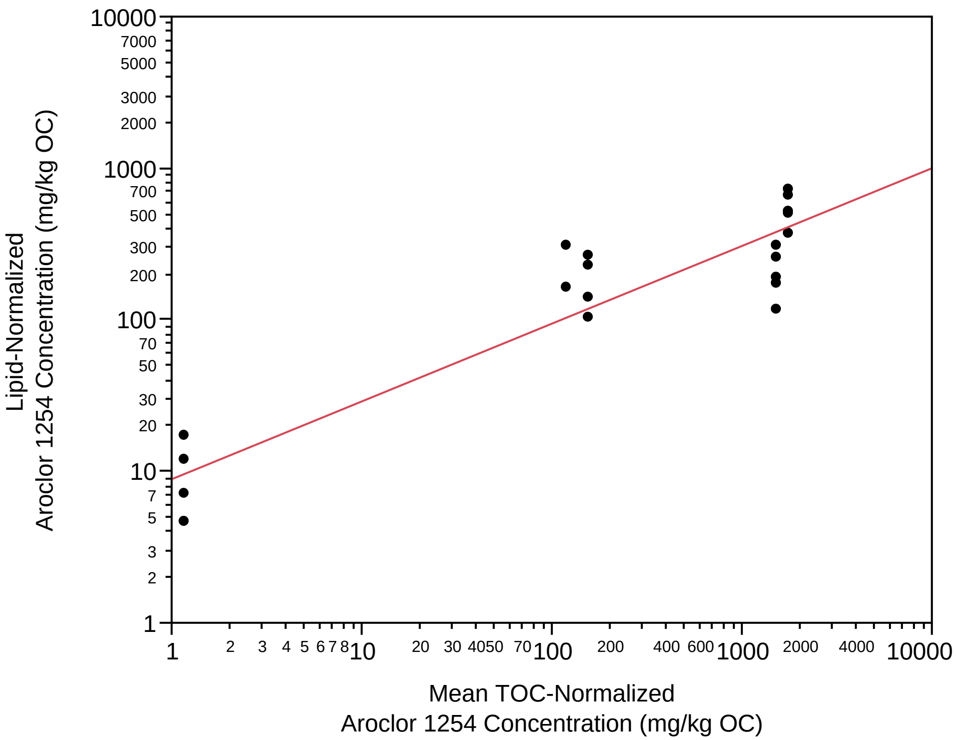
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.2257132	0.435785	2.81	0.0111*
Log(0.25 Mean Sed A1254/TOC (mg/kg))	0.5857694	0.075088	7.80	<.0001*

Notes:

1. TOC-Normalized sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles of each tissue sampling location.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – Lipid-Normalized Aroclor 1254 vs. Mean TOC-Normalized Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-17



Transformed Fit Log to Log

Log(Whole Body_Lipid Norm A1254 (mg/kg)) = 2.2032416 + 0.5128603*Log(Mean TOC Norm A1254 (mg/kg OC))

Summary of Fit

RSquare	0.861178
RSquare Adj	0.853871
Root Mean Square Error	0.625132
Mean of Response	4.755473
Observations (or Sum Wgts)	21

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	46.060716	46.0607	117.8658
Error	19	7.425001	0.3908	**Prob > F**
C. Total	20	53.485717		<.0001*

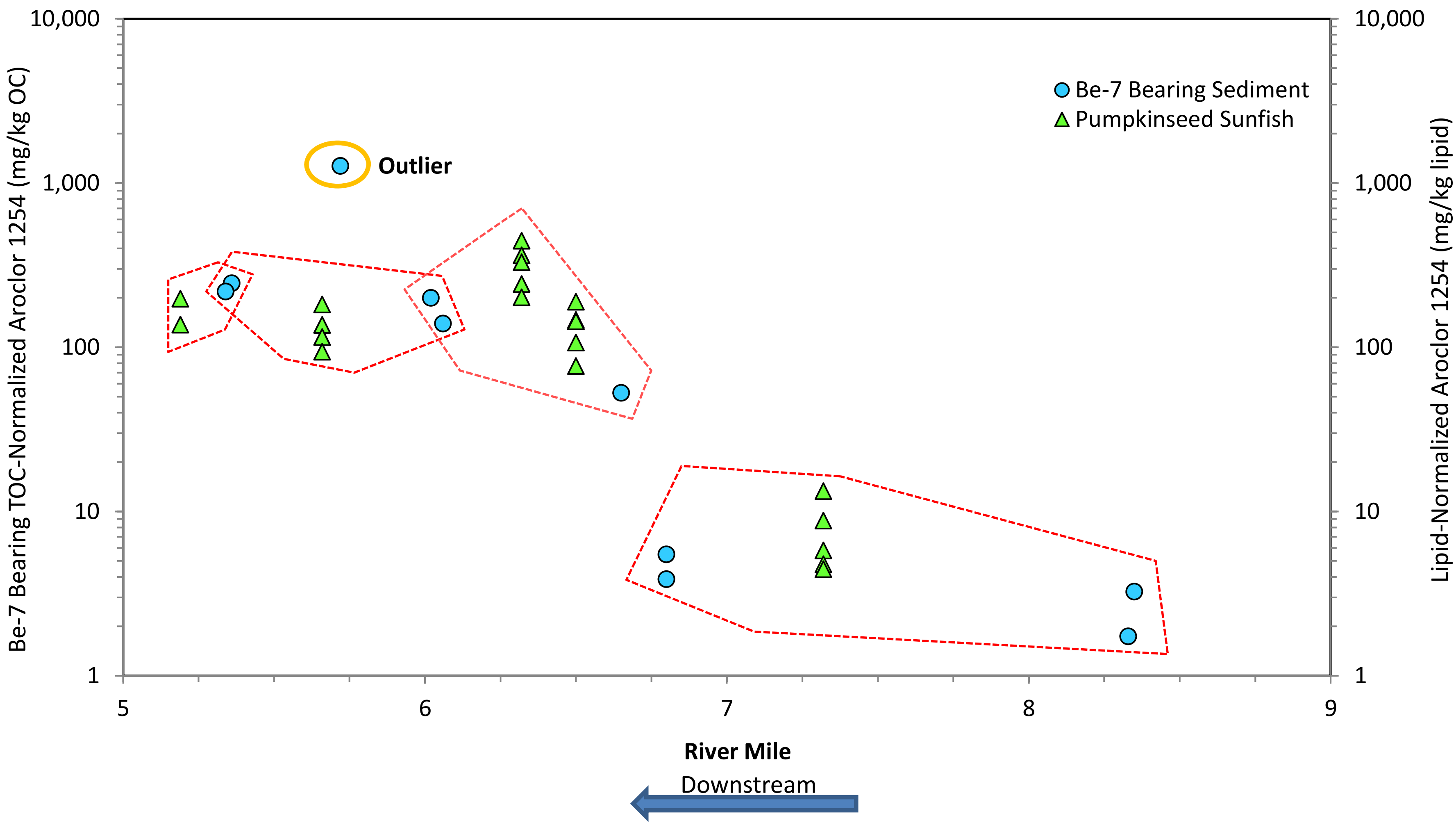
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2.2032416	0.271798	8.11	<.0001*
Log(Mean TOC Norm A1254 (mg/kg OC))	0.5128603	0.047239	10.86	<.0001*

Notes:

1. TOC-Normalized sediment concentrations were estimated as the average of all sediment samples in an area ± 0.25 miles of each tissue sampling location.

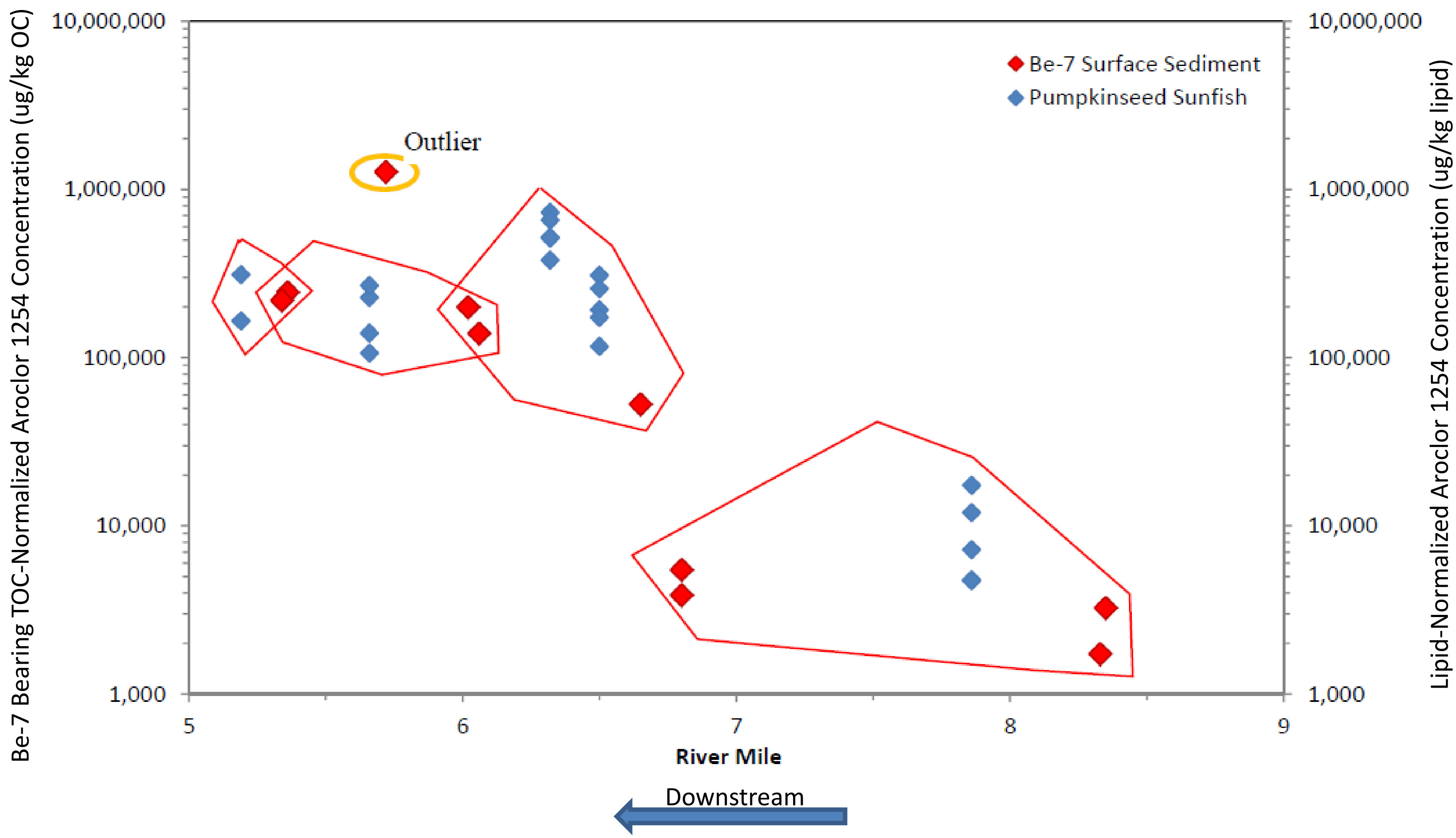
	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – Lipid-Normalized Aroclor 1254 vs. Mean TOC-Normalized Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-18



Notes:

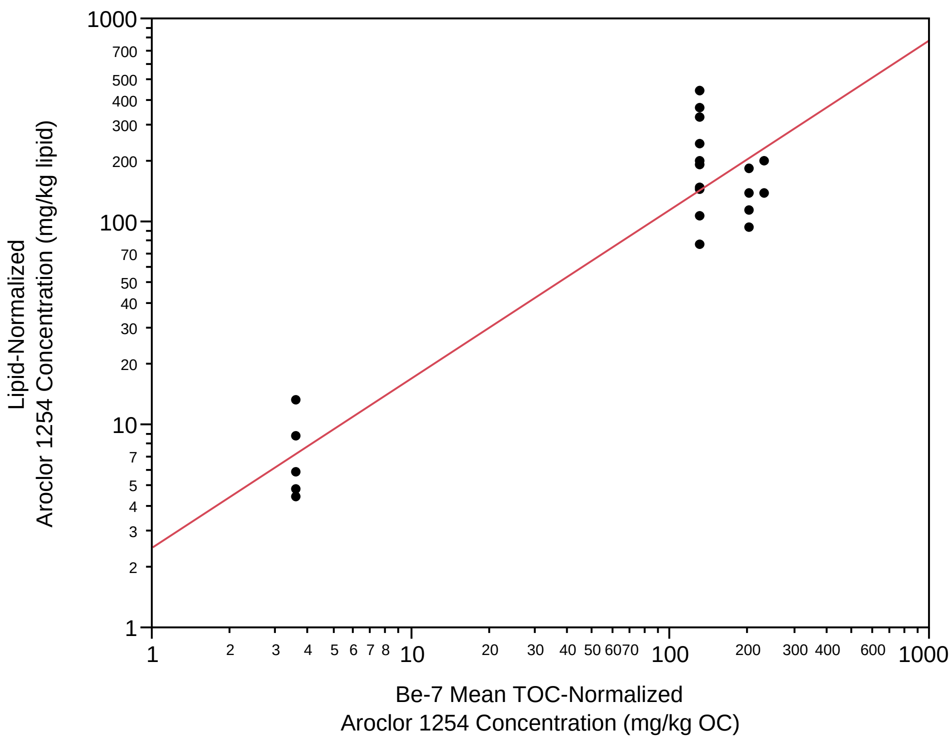
1. Be-7 bearing surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. White sucker tissue samples were obtained from USEPA 2008 field investigation program.
3. Red polygon-like shapes represent the fish-sediment matching pairs.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – Lipid-Normalized and Be-7 TOC-Normalized Aroclor 1254 Concentrations vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-19



Notes:
1. Be-7 bearing surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. White sucker tissue samples were obtained from USEPA 2008 field investigation program.
3. Red polygon-like shapes represent the fish-sediment matching pairs.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – Lipid-Normalized and Be-7 TOC-Normalized Aroclor 1254 Concentrations vs. River Mile** *Bound Brook OU4 RI/FS*	2014 FIGURE D-20



Transformed Fit Log to Log

Log(Lipid Normalized A1254 (mg/kg)) = 0.9176461 + 0.8332785*Log(TOC normalized Sediment A1254 (ppm))

Summary of Fit

RSquare	0.863765
RSquare Adj	0.856595
Root Mean Square Error	0.563961
Mean of Response	4.379697
Observations (or Sum Wgts)	21

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	38.314188	38.3142	120.4650
Error	19	6.042998	0.3181	**Prob > F**
C. Total	20	44.357186		<.0001*

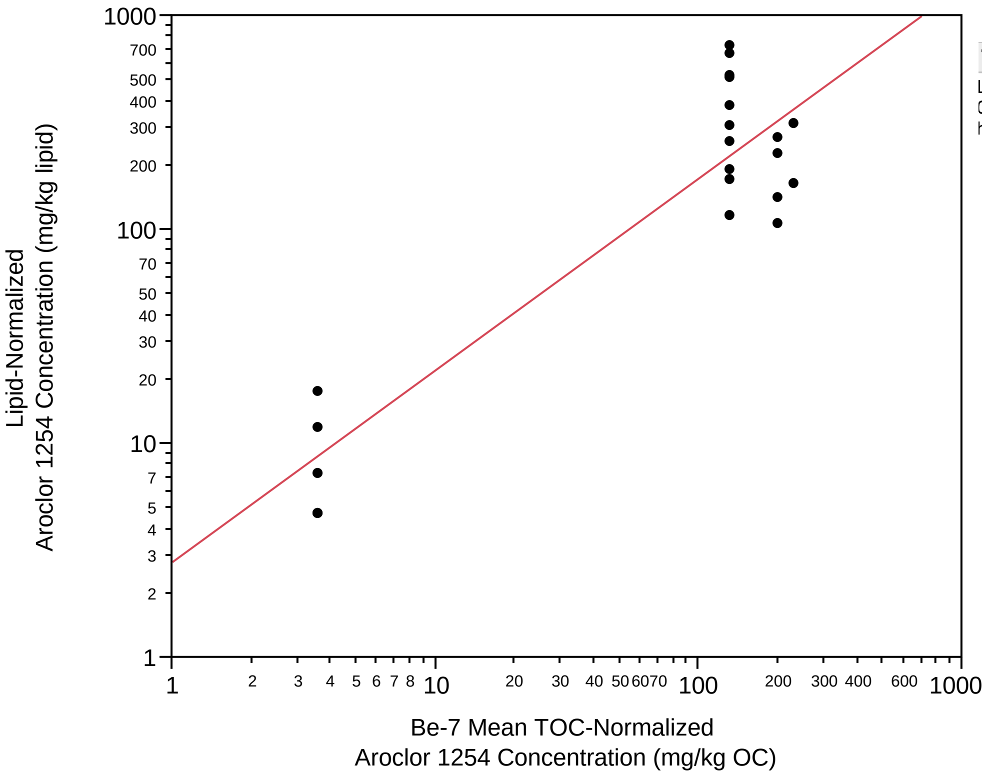
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.9176461	0.338587	2.71	0.0139*
Log(TOC normalized Sediment A1254 (ppm))	0.8332785	0.075921	10.98	<.0001*

Notes:

1. Be-7 TOC-Normalized surface sediment concentrations were estimated as the average of all sediment samples nearby each tissue sampling location (see figure D-19 for fish-sediment matching pairs).
2. One Be-7 TOC-Normalized surface sediment concentration at (RM5.72, 1,270 mg/kg OC) was excluded in the above analysis.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – Lipid-Normalized Aroclor 1254 vs. Be-7 Mean TOC-Normalized Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-21



Transformed Fit Log to Log

Log(Whole Body_Lipid Norm A1254 (mg/kg)) = 1.0311066 + 0.8968571*Log(Mean Be-7 TOC Norm A1254 (mg/kg OC) without high conc. 2)

Summary of Fit

RSquare	0.829205
RSquare Adj	0.820216
Root Mean Square Error	0.693393
Mean of Response	4.755473
Observations (or Sum Wgts)	21

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	44.350642	44.3506	92.2447
Error	19	9.135075	0.4808	Prob > F
C. Total	20	53.485717		<.0001*

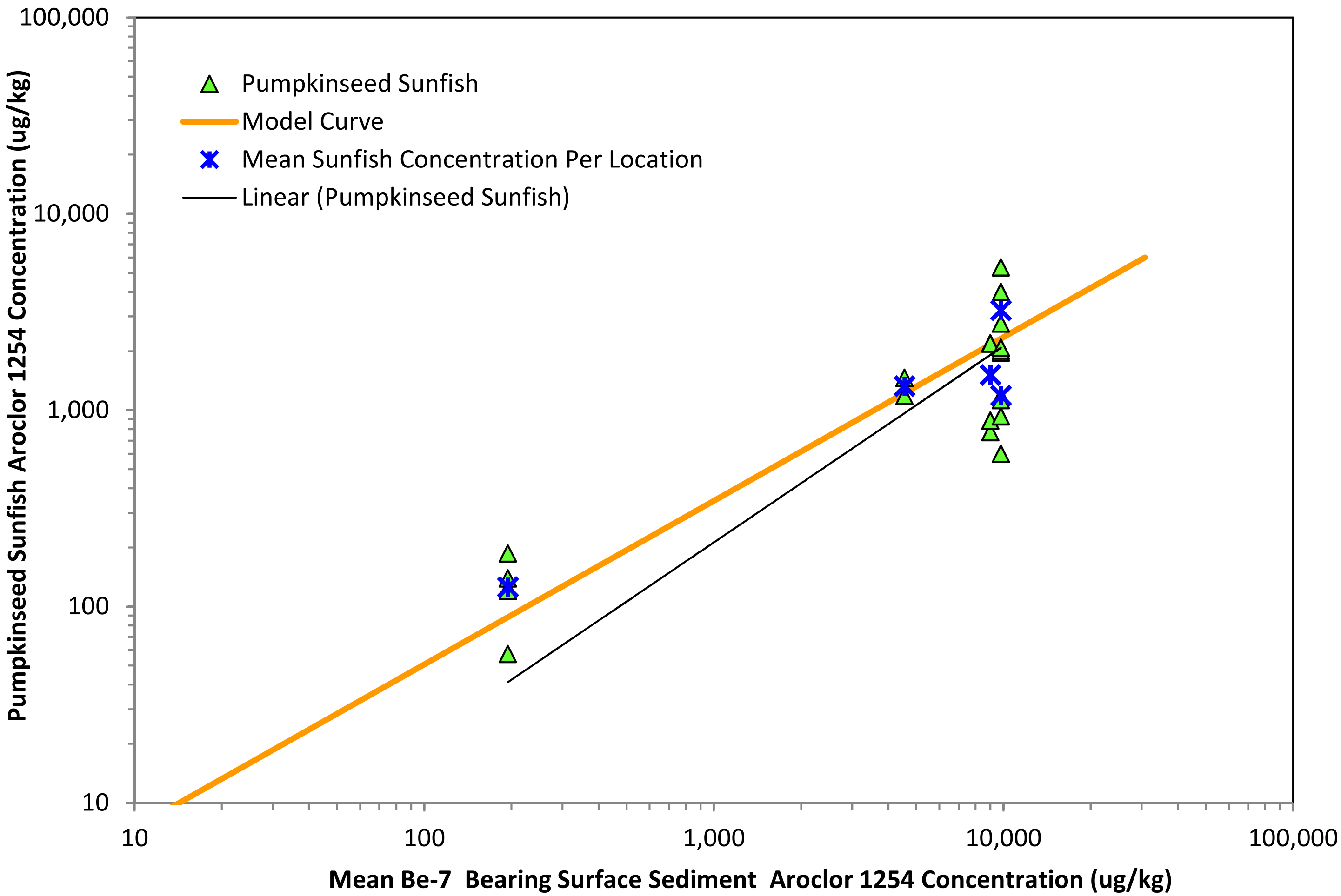
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.0311066	0.416252	2.48	0.0228*
Log(Mean Be-7 TOC Norm A1254 (mg/kg OC) without high conc. 2)	0.8968571	0.09338	9.60	<.0001*

Notes:

1. Be-7 TOC-Normalized surface sediment concentrations were estimated as the average of all sediment samples nearby each tissue sampling location (see figure D-20 for fish-sediment matching pairs).
2. One Be-7 TOC-Normalized surface sediment concentration at (RM5.72, 1,270 mg/kg OC) was excluded in the above analysis.

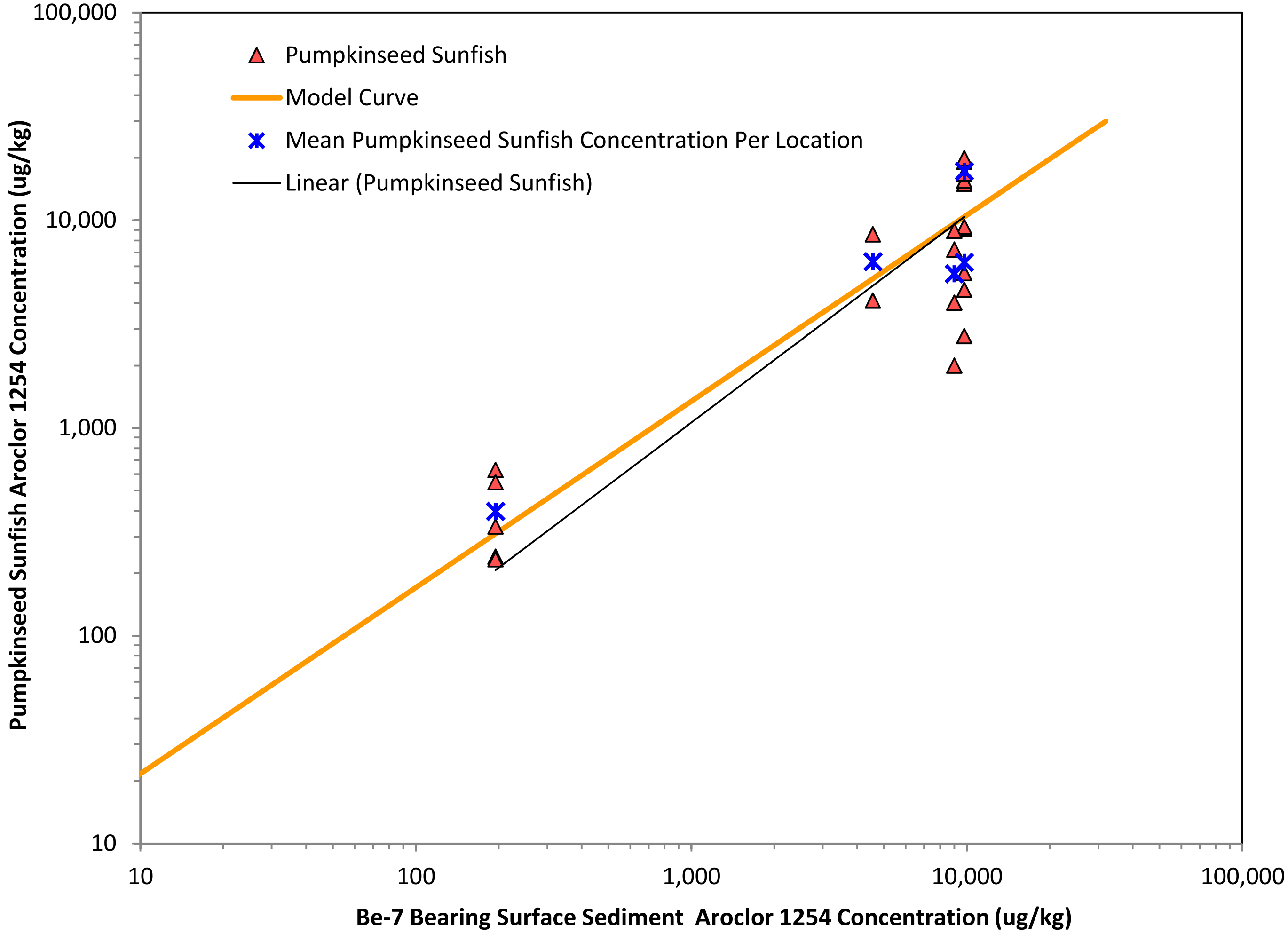
	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – Lipid-Normalized Aroclor 1254 vs. Be-7 Mean TOC-Normalized Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-22



Notes:

1. Be-7 bearing surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. Pumpkinseed sunfish tissue samples were obtained from USEPA 2008 field investigation program.
3. See figure D-19 for the fish-sediment matching pairs.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Fillet – Tissue Aroclor 1254 Concentration vs. Mean Be-7 Bearing Sediment Aroclor 1254 Concentrations** *Bound Brook OU4 RI/FS*	2014 FIGURE D-23



Notes:

1. Be-7 bearing surface sediment samples were obtained from LBG 2011 Remedial Investigation.
2. Pumpkinseed sunfish tissue samples were obtained from USEPA 2008 field investigation program.
3. See figure D-20 for the fish-sediment matching pairs.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Pumpkinseed Sunfish Whole Body – Tissue Aroclor 1254 Concentration vs. Mean Be-7 Bearing Sediment Aroclor 1254 Concentration** *Bound Brook OU4 RI/FS*	2014 FIGURE D-24

Attachment D-1

Algebraic Solutions of Equations Used to Calculate Ecological Risk-Based PRGs for Sediment and Floodplain Soil, and Example PRG Calculations

Equation 1: Calculation of PRGsed for Invertebrate Critical Body Residue (CBR)

Basic relationships

$$\text{BSAF} = \frac{\text{Cinvert / invert \% lipid}}{\text{Csed / \% TOC}}$$

Solving for Csed:

$$\text{Csed} = \frac{\text{Cinvert x \% TOC}}{\text{BSAF x \% invert lipid}}$$

where:

Csed = PRGsed; Cinvert = invertebrate CBR

Example solution for CBR-NOAEL

$$\text{PRGsed} = \frac{\text{0.11 mg/kg x 5.13}}{\text{1.62 x 1.8}} \quad = \text{1.9E-01 mg/kg}$$

Equation 2: Calculation of PRGsed for Fish Critical Body Residue (CBR)

Basic relationships

$$\text{Cfish} = \frac{\text{BSAFfish x fish \% lipid x Csed}}{\text{\% TOC}}$$

where:

$$\log(\text{Cfish / fish \% lipid}) = 1.03 + 0.897 \text{ x } \log(\text{Csed / \% TOC})$$

Solving for Csed, reduced to:

$$\text{Csed} = 0.719 \text{ x } \exp(\ln(\text{Cfish})/0.897)$$

where:

fish % lipid = 3.34; % TOC = 5.13

and where:

Csed = PRGsed; Cfish = fish CBR

Example solution for CBR-NOAEL

$$\text{PRGsed} = 0.719 \text{ x } \exp(\ln(0.014)/0.897) \quad = 6.2\text{E-03 mg/kg}$$

Equation 3: Calculation of PRGsed for Critical Bird Egg Residue

<u>Basic relationships</u>

$$\text{Bird egg BMF} = \frac{\text{Cbird egg / bird egg \% lipid}}{\text{Cfish / fish \% lipid}}$$

$$\text{Cfish} = \frac{\text{Cbird egg x fish \% lipid}}{\text{Bird egg BMF x bird egg \% lipid}}$$

where:

Cbird egg = critical bird egg residue

and where:

log(Cfish / fish % lipid) = 1.03 + 0.897 x log (Csed / % TOC)

<u>Solving for Csed, reduced to:</u>

Csed = 0.719 x exp(ln(Cfish)/0.897)

where:

fish % lipid = 3.34; % TOC = 5.13

and where:

Csed = PRGsed

<u>Example solution for CBR-NOAEL</u>

$$\text{Cfish} = \frac{\text{1.1 mg/kg x 7.7}}{\text{16 x 3.34}} = \text{0.03 mg/kg}$$

PRGsed = 0.719 x exp(ln(0.03)/0.897) = 1.4E-02 mg/kg

Equation 4: Calculation of PRGsed for Piscivorous Bird

Basic relationships

$$HQ = \frac{Intake}{TRV}$$

Intake = HQ x TRV

where:

$$Intake = \frac{Cfish \times IRf \times PFf + Cinvert \times IRf \times PFinvert + Csed \times IRsed}{BW}$$

$$Intake = \frac{\frac{BASFfish \times fish\ \%\ lipid \times Csed}{\%\ TOC} \times IRf \times PFf + \frac{BASFinvert \times invert\ \%\ lipid \times Csed}{\%\ TOC} \times IRf \times PFf + Csed \times IRsed}{BW}$$

where:

$$Cfish = \frac{BSAFfish \times fish\ \%\ lipid \times Csed}{\%\ TOC}$$

and:

$$Cinvert = \frac{BSAFinvert \times invert\ \%\ lipid \times Csed}{\%\ TOC}$$

and where:

log(Cfish / fish % lipid) = 1.03 + 0.897 x log (Csed / % TOC)

where:

$$BSAFinvert = \frac{Cfish\ /\ invert\ \%\ lipid}{Cinvert\ /\ \%\ TOC}$$

reduced to:

Csed = 0.719 x exp(ln(Cfish)/0.897)

where:

fish % lipid = 3.34; % TOC = 5.13

Solving for Csed:

$$Csed = \frac{HQ \times BW \text{ X } TRV}{((BSAFfish \times fish\ \%\ Lipid)/\%\ TOC) \times IRf \times PFfish} + \frac{HQ \times BW \times TRV}{(((BSAFinvert \times Invert\ \%\ Lipid)/\%\ TOC) \times IRf \times PFinvert) + IRsed}$$

where:

Csed = PRGsed for piscivorous bird; HQ = Target hazard quotient

Example solution for TRV-NOAEL

$$PRGsed = 0.719 \times \exp(\ln(\frac{1 \times 0.15\ kg \times 0.11\ mg/kg\text{-}day}{0.075\ kg/day \times 0.7})/0.897) + \frac{1 \times 0.15\ kg \times 0.11\ mg/kg\text{-}day}{(((1.62 \times 1.8)/5.13) \times 0.075\ kg/day \times 0.3) + 0.0004\ kg/day}$$

= 1.4E+00 mg/kg

Equation 5: Calculation of PRGsed for Insectivorous Bird

Basic relationships

$$HQ = \frac{\text{Intake}}{\text{TRV}}$$

$$\text{Intake} = HQ \times TRV$$

where:

$$\text{Intake} = \frac{\text{Cfish} \times \text{IRf} \times \text{PFf} + \text{Csed} \times \text{IRsed}}{\text{BW}}$$

$$\text{Intake} = \frac{\dfrac{\text{BASF} \times \text{fish \% lipid} \times \text{Csed}}{\text{\% TOC}} \times \text{IRf} \times \text{PFf} + \text{Csed} \times \text{IRsed}}{\text{BW}}$$

where:

$$\text{BSAF} = \frac{\text{Cfish / fish \% lipid}}{\text{Csed / \% TOC}}$$

$$\text{Cfish} = \frac{\text{BSAF} \times \text{fish \% lipid} \times \text{Csed}}{\text{\% TOC}}$$

Solving for Csed:

$$\text{Csed} = \frac{\text{HQ} \times \text{BW} \times \text{TRV}}{(((\text{BSAFinvert} \times \text{Invert \% Lipid})/\text{\% TOC}) \times \text{IRf} \times \text{PFinvert}) + \text{IRsed}}$$

where:

Csed = PRGsed for insectivorous bird; HQ = Target hazard quotient

Example solution for TRV-NOAEL

$$\text{PRGsed} = \frac{1 \times 0.053 \text{ kg} \times 0.11 \text{ mg/kg-day}}{(((1.62 \times 1.8)/5.13) \times 0.042 \text{ kg/day} \times 1) + 0.0001 \text{ kg/day}} = 2.4\text{E-01 mg/kg}$$

Equation 6: Calculation of PRGsed for Piscivorous Mammal

<u>Basic relationships</u>

$$HQ = \frac{Intake}{TRV}$$

$$Intake = HQ \times TRV$$

where:

$$Intake = \frac{Cfish \times IRf \times PFf + Cinvert \times IRf \times PFinvert + Csed \times IRsed}{BW}$$

$$Intake = \frac{\frac{BASFfish \times fish\ \%\ lipid \times Csed}{\%\ TOC} \times IRf \times PFf + \frac{BASFinvert \times invert\ \%\ lipid \times Csed}{\%\ TOC} \times IRf \times PFf + Csed \times IRsed}{BW}$$

where:

$$Cfish = \frac{BSAFfish \times fish\ \%\ lipid \times Csed}{\%\ TOC}$$

and:

and:

$$Cinvert = \frac{BSAFinvert \times invert\ \%\ lipid \times Csed}{\%\ TOC}$$

and where:

$$\log(Cfish / fish\ \%\ lipid) = 1.03 + 0.897 \times \log(Csed / \%\ TOC)$$

where:

$$BSAFinvert = \frac{Cfish / invert\ \%\ lipid}{Cinvert / \%\ TOC}$$

<u>Solving for Csed, reduced to:</u>

$$Csed = 0.719 \times \exp(\ln(Cfish)/0.897)$$

where:

fish % lipid = 3.34; % TOC = 5.13

Solving for Csed:

$$Csed = \frac{HQ \times BW\ X\ TRV}{((BSAFfish \times fish\ \%\ Lipid)/\%\ TOC) \times IRf \times PFfish} + \frac{HQ \times BW \times TRV}{(((BSAFinvert \times Invert\ \%\ Lipid)/\%\ TOC) \times IRf \times PFinvert) + IRsed}$$

where:

Csed = PRGsed for piscivorous mammal; HQ = Target hazard quotient

<u>Example solution for TRV-NOAEL</u>

$$PRGsed = 0.719 \times \exp(\ln(\frac{1 \times 1\ kg \times 0.11\ mg/kg\text{-}day}{0.21\ kg/day \times 0.88})/0.897) + \frac{1 \times 1\ kg \times 0.11\ mg/kg\text{-}day}{(((1.62 \times 1.8)/5.13) \times 0.21\ kg/day \times 0.12) + 0.001\ kg/day} = 7.6E+00\ mg/kg$$

Equation 7: Calculation of PRGsed for Insectivorous Mammal

Basic relationships

$$HQ = \frac{\text{Intake}}{\text{TRV}}$$

$$\text{Intake} = \text{HQ x TRV}$$

where:

$$\text{Intake} = \frac{\text{Cinvert x IRf x PFinvert + Csed x IRsed}}{\text{BW}}$$

$$\text{Intake} = \frac{\dfrac{\text{BASFinvert x invert \% lipid x Csed}}{\text{\% TOC}}\text{ x IRf x PFf + Csed x IRsed}}{\text{BW}}$$

where:

$$\text{Cinvert} = \frac{\text{BSAFinvert x invert \% lipid x Csed}}{\text{\% TOC}}$$

and where:

$$\text{BSAFinvert} = \frac{\text{Cinvert / invert \% lipid}}{\text{Csed / \% TOC}}$$

Solving for Csed:

$$\text{Csed} = \frac{\text{HQ x BW x TRV}}{\text{(((BSAFinvert x Invert \% Lipid)/\% TOC) x IRf x PFinvert) + IRsed}}$$

where:

Csed = PRGsed for insectivorous mammal; HQ = Target hazard quotient

Example solution for TRV-NOAEL

$$\text{PRGsed} = \frac{\text{1 x 0.008 kg x 0.305 mg/kg-day}}{\text{((1.62 x 1.8)/5.13) x 0.007 kg/day x 1}} \qquad \text{= 6.1E-01 mg/kg}$$

Equation 8: Calculation of PRGsed for Herbivorous Mammal

Basic relationships

$$HQ = \frac{\text{Intake}}{\text{TRV}}$$

$$\text{Intake} = HQ \times TRV$$

where:

$$\text{Intake} = \frac{\text{Cplant} \times \text{IRf} \times \text{PFplant} + \text{Csed} \times \text{IRsed}}{\text{BW}}$$

$$\text{Intake} = \frac{\text{Csed} \times \text{BAFplant} \times \text{IRf} \times \text{PFplant} + \text{Csed} \times \text{IRsed}}{\text{BW}}$$

where:

$$\text{Cplant} = \text{Csed} \times \text{BAFplant}$$

and where:

$$\text{BAFplant} = \frac{\text{Cplant}}{\text{Csed}}$$

Solving for Csed:

$$\text{Csed} = \frac{HQ \times BW \text{ X } TRV}{(\text{BAFplant} \times \text{IRf} \times \text{Pfplant}) + \text{IRsed}}$$

where:

Csed = PRGsed for herbivorous mammal; HQ = Target hazard quotient

Example solution for TRV-NOAEL

$$\text{PRGsed} = \frac{1 \times 1.2 \text{ kg} \times 0.305 \text{ mg/kg-day}}{0.124 \times 0.48 \text{ kg/day} \times 1 + 0.0058} = 5.6E{+}00 \text{ mg/kg}$$

Equation 9: Calculation of PRGsoil for Insectivorous Bird and Insectivorous Mammal

Basic relationships

$$HQ = \frac{\text{Intake}}{\text{TRV}}$$

Intake = HQ x TRV

where:

$$\text{Intake} = \frac{\text{Cinvert x IRf x PFinvert + Csoil x IRsoil}}{\text{BW}}$$

$$\text{Intake} = \frac{\text{Csoil x BAFinvert x IRf x PFinvert + Csoil x IRsoil}}{\text{BW}}$$

where:

Cinvert = Csoil x BAFinvert

Solving for Csoil:

$$\text{Csoil} = \frac{\text{HQ x BW X TRV}}{\text{(BAFinvert x IRf x PFinvert) + IRsoil}}$$

where:

Csoil = PRGsoil for insectivorous bird or mammal; HQ = Target hazard quotient

Example solution for insectivorous bird for TRV-NOAEL

$$\text{PRGsed} = \frac{\text{1 x 0.081 kg x 0.11 mg/kg-day}}{\text{1.05 x 0.098 kg/day x 1 + 0.002}} \qquad = \text{8.5E-02 mg/kg}$$

Appendix E:

Presumptive Remedy Guidance

(Appendices C and D, Ex situ Treatment Technologies for Groundwater (from Presumptive Response Strategy and Ex situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites. Directive 9283.1-12. EPA 540/R-96/023. October 1996.)

APPENDIX C

Ex-Situ Treatment Technologies for Ground Water

Appendix C1: Ex-Situ **Technologies Considered** in Sample of 25 Sites

Appendix C2: **Other Components** Needed for Treatment Trains

Appendix C3: **Information Needed** for Selection of Technologies and Design of Treatment Train

Appendix C4: **Advantages and Limitations** of Presumptive Treatment Technologies

Appendix C1: Ex-Situ Technologies Considered in Sample of 25 Sites

Technologies that were **considered** for treatment of extracted ground in the sample of 25 sites reviewed in detail (EPA, 1996b) are listed below. These technologies were either considered in the feasibility study (FS), or considered and/or selected in the record of decision (ROD) or remedial design. The technologies are listed according to overall process type, and by design style within each type. Those technologies identified as **presumptive technologies** are also indicated. For further information on how presumptive technologies were identified, refer to Section 3.2 of this guidance and EPA, 1996b.

For Treatment of **Organic** Contaminants:

__**Presumptive Technologies:**__

Air stripping:
- Packed tower
  - Ambient temperature
  - Higher temperature
- Aeration methods
  - Ambient temperature
  - Higher temperature
- Cascade falls

Granular activated carbon (GAC)

Chemical/UV oxidation:
- Chemical oxidation alone
  - Ozone
  - Hydrogen peroxide
  - Chlorine compounds
  - Potassium permanganate
- Chemical with UV oxidation
  - Ozone
  - Hydrogen peroxide
- UV oxidation alone (photolysis)
- Alkaline chlorination (**for cyanide**)
- Unspecified oxidation methods

Aerobic biological reactors:
- Attached growth
  - Trickling filter
  - Rotating biological contactors
  - Fixed bed
- Suspended growth
  - Activated sludge
  - Sequencing batch reactors
  - Aeration ponds/lagoons
  - Unspecified suspended growth
- Unspecified aerobic reactors

For Treatment of **Metals**:

Chemical precipitation:
- Hydroxide precipitants
  - Sodium hydroxide
  - Lime
  - With prior chemical reduction
- Sulfide precipitants
  - Sulfur dioxide
  - Sodium sulfide
  - Sodium bisulfide/bisulfites
  - With prior chemical reduction
  - Unspecified sulfide precipitant
- Other precipitation methods
  - Ferrous sulfate
  - Potassium permanganate
  - Activated consumable element
  - Unspecified chemical precipitation

Ion exchange/adsorption:
- Fixed bed
  - Impregnated/synthetic resin
  - Activated alumina
- Electrodialysis
- Unspecified ion exchange

Electrochemical methods:
- Electrochemical reduction
- Magnetically activated

Aeration of Background Metals:
- Aeration basin
- Cascade aeration
- Other aeration methods

Appendix C1: Ex-Situ Technologies Considered in Sample of 25 Sites (continued)

For Treatment of **Organic** Contaminants:

Other Technologies Considered:

Chemical treatment:

- Hydrolysis
- Catalytic dehydrochlorination
- Catalytic dechlorination
- Chlorinolysis

Thermal Destruction:

- Incineration
- Calcination
- Wet air oxidation
- Supercritical water oxidation
- Microwave discharge/plasma

High temperature separation:

- Steam stripping
- Distillation

Membrane filtration:

- Reverse osmosis
- Ultrafiltration

Anaerobic biological treatment:

- Anaerobic biological reactor
- Enzymatic degradation

Liquid-liquid extraction:

- Solvent extraction
- Liquid carbon dioxide extraction

Evaporation:

- Evaporation basin

Land treatment:

- Surface spreading
- Spray irrigation

For Treatment of **Metals**:

Granular activated carbon (for metals)

Reverse Osmosis

Biological treatment of metals

Appendix C2: Other Components Needed for Treatment Trains [1]

Solid or Liquid Separation Technologies	Effluent Polishing Technologies[2]	Vapor Phase Treatment Technologies[3]
• Oil/grease separation[4]	• Activated carbon	• Activated carbon
• Filtration[5]	• Ion exchange	• Resin adsorption
• Coagulation[5] (or flocculation)	• Neutralization	• Catalytic oxidation
• Clarification[5] (or sedimentation)		• Thermal incineration
		• Acid gas scrubbing
		• Condensation

General Sequence of Unit Processes Used in Aqueous Treatment Trains

Sequence	Unit Treatment Process	Treatment Stage
Begin	Equalize inflow	Pretreatment
	Separate solid particles	Pretreatment
	Separate oil/grease (NAPLs)	Pretreatment
	Remove metals	Treatment
	Remove volatile organics	Treatment
	Remove other organics	Treatment
	Polish organics[2]	Post-treatment
	Polish metals	Post-treatment
End	Adjust pH, if required	Post-treatment

NOTES:

1 In addition to the presumptive technologies listed in the guidance, other treatment components are needed either prior to (pretreatment) or subsequent to (post-treatment) the presumptive technologies. <u>This listing is not intended to be presumptive.</u> Not listed are technologies that may be required for treatment residuals, such as spent carbon.

2 Effluent polishing technologies are those used for the final stage of treatment prior to discharge, and can include pH adjustment (neutralization) as well as additional removal of aqueous constituents.

3 Vapor phase contaminants released during water treatment may need to be contained and treated. This includes organic contaminants volatilized during air stripping, from biological treatment, or other gases released from chemical oxidation, reduction or biologic processes (e.g., hydrochloric acid, hydrogen sulfide, methane, etc.).

4 Methods for separation of oil and/or grease from water include, but are not limited to, gravity separation and dissolved air floatation. These methods can be used to remove NAPLs from the extracted ground water.

5 These technologies can be used to remove solid particles at the beginning of the treatment train or for removal of other solids resulting from chemical precipitation, chemical/UV oxidation or biological treatment.

Appendix C3: Information Needed for Selection of Technologies and Design of Treatment Train

Information Needed	Purpose of Information
1. Total extraction flow rate: • Total extracted flow • Flow variability • Uncertainty of estimate	**Inflow** to the treatment system is the total flow from all extraction wells. Since this flow must also be discharged, large flows may determine the availability of some discharge options. Flow rate and concentration determines the mass loading (mass per unit water volume) of each contaminant entering the treatment system. The mass loading determines the dimensions and capacities of treatment vessels, and whether continuous flow or batch design are used for each treatment unit. Flow is also a factor for selecting among the presumptive treatment technologies because some are less cost effective for high or low flows. **Variable inflow** rates may require use of flow equalization tanks, batch instead of continuous flow operation or use of modular treatment units that can be added or subtracted from the treatment train. Some technologies can handle variable flow more easily than others. Variable extraction rates may result from short-term operational changes, seasonal changes or phased well installation. **Uncertainty** in the flow estimate can result from natural variability of aquifer properties over the site, and from the method used to measure these properties. Since flow is a critical design parameter, additional characterization may be needed to reduce the level of uncertainty. **Estimates of the total extraction rate should be based on pumping type aquifer tests, since this method provides a much better estimate of average aquifer properties than other methods.**

Appendix C3: Information Needed for Selection of Technologies and Design of Treatment Train (continued)

Information Needed	Purpose of Information
2. Discharge options and effluent requirements: • Options available • Target effluent concentrations, each option - Contaminants - Contaminant degradation products - Treatment additives - Natural constituents - Water quality parameters • Other requirements, each option - Regulatory - Operational • Community concerns or preferences	Options for discharge of treated ground water could include: discharge to surface waters; discharge to a drinking water system; reuse or recycling for other purposes (e.g., industrial processes); infiltration or reinjection to shallow subsurface or reinjection to the same aquifer; or discharge to POTW. Target effluent concentration levels for both contaminants and naturally occurring constituents may be markedly different for each discharge option. Effluent requirements could include those for chemicals added during treatment, contaminant degradation products, naturally occurring constituents (e.g., arsenic), and water quality parameters (e.g., suspended solids) in addition to maximum concentration levels for chemicals of concern. These requirements will determine the overall level of treatment needed, which in turn determines the type of components needed in the treatment train and is a critical factor in selecting appropriate treatment technologies. Each discharge option may have different water quality requirements for the treated effluent, from both a **regulatory** and **operational** standpoint. For example, reinjection to the subsurface must meet substantive federal and/or state requirements for underground injection (regulatory) as well as minimize chemical and biological clogging of injection wells or infiltration lines (operational). Use of the best available technology (BAT) could also be a regulatory requirement. The **affected community** may also have concerns or preferences regarding the type of discharge. **Target effluent concentrations** determine the overall removal efficiency the treatment train must attain for each constituent. For example, if the target effluent level is 10 mg/L and the inflow concentration is 1000 mg/L, then the treatment train must attain an overall removal efficiency of 99.0 percent (1000 - 0.99(1000) = 10). The treatment train may need to include more than one type of technology, or multiple units of a single technology, in order to attain the required overall removal efficiency.

Appendix C3: Information Needed for Selection of Technologies and Design of Treatment Train (continued)

Information Needed	Purpose of Information
3. Water quality of treatment influent: • Contaminant types and concentrations: - Inorganic chemicals - Organic chemicals - Concentration changes over time - Nonaqueous phase liquids (NAPLs) • Naturally occurring constituents: - Major cations (metals) and anions - Organic chemicals - Radionuclides	**Contaminant types and concentrations** must be estimated for the total flow entering the treatment system. Since some technologies are more effective in removing certain contaminant types, this is an important technology selection factor. Inflow concentrations are needed to determine the removal efficiency of the treatment train, as discussed above. **The design should consider the potential for inflow concentrations to change over time.** Contaminant concentrations usually decrease as remediation progresses. Also, short term increases may occur if a "hot spot" of more highly contaminated ground water is captured by the extraction system. Samples obtained from **pumping type aquifer tests provide better estimates of average contaminant concentrations**, because such samples are obtained from a relatively large aquifer volume. If present, subsurface **NAPLs** (refer to Appendix A1) may become entrained in the extracted ground water. These immiscible liquids should be removed in a pretreatment step (process used prior to other treatment methods). Also, a specialized extraction system may be needed to remove free-phase NAPLs from the subsurface. **Naturally occurring** or non-site related constituents may need to be removed to prevent interference with treatment processes and may be a factor in technology selection. **Metals** such as iron, manganese, and calcium can leave mineral deposits (scaling) on air stripper packing and on activated carbon or other treatment media. If not accounted for, these metals can also cause premature exhaustion of ion exchange capacity and increased consumption of reagents in chemical oxidation or precipitation processes. Iron also promotes biological fouling in air strippers. Heavy metals (e.g., lead, mercury) and cyanides can be toxic to microorganisms in biological reactors. Metals can also form deposits on well screens of extraction or reinjection wells (encrustation) or promote biological fouling (clogging) on well screens.

Appendix C3: Information Needed for Selection of Technologies and Design of Treatment Train (continued)

Information Needed	Purpose of Information
3. Water quality of influent (continued): ● Other water quality parameters: - Indicator parameters - Design parameters	Dissolved **organic constituents** (e.g., from decay of organic materials or from landfill leachate) can interfere with adsorption of targeted compounds and can cause premature exhaustion of activated carbon. Metal-organic complexes can interfere with chemical oxidation or precipitation processes. If present, naturally occurring **radionuclides** can accumulate in treatment media or residuals (e.g., activated carbon or chemical sludges) resulting in potential exposure hazards for personnel and additional transportation and disposal considerations. Other water quality parameters are used as effluent quality standards, indicator parameters, or design parameters for treatment processes. **Indicator parameters** are used to indicate the presence of other constituents. For example, total dissolved carbon (TDC) is a measure of the relative level of dissolved organic constituents. Gross alpha and gross beta particle activity are relatively simple measurements that indicate the relative abundance of **naturally occurring radionuclides**. Other indicator parameters include: total dissolved solids (TDS), chemical oxygen demand (COD), biological oxygen demand (BOD) and total suspended solids (TSS). Temperature and pH are **design parameters** for most treatment processes. Also, high levels of total suspended solids (TSS) in extracted ground water may indicate that extraction wells are not properly designed or developed. Most treatment technologies require that suspended solids in excess of certain level be removed during pretreatment, where acceptable levels may differ for each technology.

Appendix C3: Information Needed for Selection of Technologies and Design of Treatment Train (continued)

Information Needed	Purpose of Information
4. Treatability information: ● From technical literature ● Treatability studies - Laboratory screening - Bench-scale testing - Pilot-scale testing ● Modeling predictions ● Projections of effluent quality	Treatability information is needed to select technology types and design styles from among the presumptive technologies; and for selection and design of other components of the treatment train. The particular mix of contaminants and naturally occurring constituents can vary considerably for different sites. Treatability information is available in the **technical literature** for some technologies, including air stripping and granular activated carbon (GAC). **Treatability studies** include 1) laboratory screening, 2) bench-scale testing, or 3) pilot-scale testing. These studies may begin with any tier and skip tiers that are not needed (see Section 3.4 of guidance). **Computer models** for predicting treatment performance are available for some technologies. In general, treatability studies should be performed prior or during the design of any system expected to provide **long-term treatment** of extracted ground water, including systems using presumptive technologies. Treatability studies are needed to accurately predict the effectiveness and cost of a technology for a given site, including construction and operating costs; and the costs of other components of the treatment train. Optimizing the cost effectiveness of the treatment train (i.e., minimizing the total cost per unit volume of water treated) is especially important for systems designed to operate over a long time period. Treatability studies **may reveal unexpected site conditions**, such as the presence of naturally occurring compounds that interfere with the planned treatment process or that metal contaminants can be effectively removed by removing mineral solids. Such studies are also needed to determine pretreatment requirements, and requirements for treating aqueous, vapor and solid waste streams resulting from a particular treatment process. Treatability studies are needed to determine optimum chemical reagents and reagent quantities for pH adjustment; oxidation, reduction or precipitation of contaminants; and parameters for design of biological and other reactors. Treatability studies should be performed on samples obtained from **pumping type aquifer tests** instead of from monitoring wells, because such samples are more representative of contaminated ground water that will enter the treatment system. Samples obtained for treatability studies should be obtained after several hours of pumping.

Appendix C4: Advantages and Limitations of Presumptive Treatment Technologies

Technology	Advantages	Limitations
Treatment Technologies for the Removal of Organic Contaminants		
Air Stripping	• Successfully used in hundreds of groundwater applications • Low operating cost relative to other technologies (e.g., energy usage is relatively low). • Operationally simple system requiring a minimum of operator assistance. • Treatability studies often not required for selection or design, but are recommended. • Trained contractors available to implement the technology.	• Contaminants transferred to air, and treatment of air emissions may be required. • Pretreatment for metals removal and pH control may be needed to reduce fouling and corrosion. • Post-treatment (polishing) may be required. • Large surges in influent concentrations can reduce removal efficiency because the efficiency for an individual compound is fixed regardless of influent concentrations. • Air stripping is not as effective for compounds with low Henry's law constants or high solubilities.[b,c] • Cold weather can reduce efficiency.
Granular Activated Carbon	• Successfully used for contaminated ground water at many Superfund and underground storage tank sites. • Operationally simple system requiring a minimum of operator assistance. • Regularly used as a <u>polishing</u> step following other treatment technologies. • Treatability studies generally not required, but are recommended (information is available from carbon vendors). • Trained contractors available to implement the technology. • Generally a cost-effective alternative as single- step treatment for flows less than about 3 gpm.[d]	• Activated carbon is generally too costly for use as a single-step treatment if ground-water chemistry requires high carbon usage rates. • Contaminants are not destroyed but are transferred to another media (i.e., spent carbon must be regenerated or disposed of properly). • Pretreatment for suspended solids removal is often required. • Pretreatment for metals removal and pH control may be needed to reduce fouling and corrosion. • Organic compounds that have low molecular weight and high polarity are not recommended for activated carbon (e.g., acetone). • Naturally occurring organic compounds may exhaust carbon bed rapidly and may interfere with the adsorption of targeted chemicals.

Appendix C4: Advantages and Limitations of Presumptive Treatment Technologies (continued)

Technology	Advantages	Limitations
Chemical/ UV Oxidation	• Where oxidation is complete, organic contaminants are <u>destroyed</u> and not transferred to other media; minimal residuals generated. • Effective on a wide variety of volatile and semivolatile organics, including chlorinated organics, as well as cyanide and some metals. • Operating costs can be competitive with air stripping and activated carbon.	• Incomplete oxidation will leave original contaminants and possibly toxic oxidation products; activated carbon polishing may be required. • Capital costs may preclude small-scale applications, especially for ozone systems. • Metals may precipitate during oxidation, requiring filtration post-treatment and residuals disposal. • UV light sources are subject to fouling and scaling from solids, iron compounds, carbonates, etc. Pretreatment may be required to remove these substances. • Process must be closely monitored to ensure contaminant destruction and to prevent safety hazards. • Peroxide and other chemical oxidants must be properly stored and handled. • Site-specific treatability studies are necessary (process may require large quantities of oxidizer to destroy target compound(s) if reactive nontarget compounds are present).
Aerobic Biological Reactors	• Organic contaminants <u>degraded</u>, often with minimal cross-media environmental impacts. • Proven effective for many organic compounds. • Some systems (e.g., trickling filters and rotating biological contactors) have minimal energy requirements and generally low capital and operating costs. • Can be designed to require a minimum of operator attention. • Relatively simple, readily available equipment. • Trained contractors available to implement the technology.	• A residual organic sludge is generated that must be disposed of properly. • Some compounds are difficult or impossible to degrade (recalcitrant) or slow to degrade. • Difficulties acclimating microorganisms to contaminants are possible; requires longer startup time than other technologies to achieve effective steady-state performance • Volatile organics may require air emission controls or pretreatment to remove them. • Variations in flow or concentration may require significant operator attention to prevent microorganisms from being killed. • Cold weather can cause operational difficulties. • Treatability studies are needed for selection and design. • Pretreatment may be needed to remove contaminants toxic to the microorganisms, such as heavy metals. • Low organic loading and the potential for supplementary nutrients and food sources must be considered.

Appendix C4: Advantages and Limitations of Presumptive Treatment Technologies (continued)

Technology	Advantages	Limitations
Treatment Technologies for the Removal of Inorganic Contaminants		
Chemical Precipitation	• Most commonly used method for removing soluble heavy metal ions from contaminated water. • Pretreatment for solids and iron generally not required. <u>Hydroxide Precipitation</u> • Reliable method, chemicals relatively easy to handle, and not costly. <u>Carbonate Precipitation</u> • Reliable method, calcium carbonate easy to handle, and not costly. • Effectively removes a variety of soluble metals. <u>Sulfide Precipitation</u> • Reliable method. • High removal efficiency over a broader pH range. • Relatively insensitive to most chelating agents. • Can remove chromates and dichromates without reducing hexavalent chromium to trivalent form if ferrous ions are present or added.	• A residual sludge is generated that must be treated and/or disposed of properly; metals are not usually easy to recover from sludge. • Up to four times stoichiometric chemical additions may be required, especially for sulfide precipitation (see below). <u>Hydroxide Precipitation</u> • Organics or complexing ions may form chelates/complexes instead of insoluble metal hydroxides. • Optimum pH is different for each metal hydroxide, one pH may not effectively treat all soluble metal ions; successive treatments may be required. • pH must be controlled within a narrow range. • Naturally occurring sulfate in ground water may react with lime to form gypsum, which increases sludge, can clog filters, and can coat pipelines (caustic soda addition can reduce this problem but increases costs and dissolved solids [sodium salts] that must be removed from treated ground water). <u>Carbonate Precipitation</u> • Calcium carbonate is not effective for ground water with high alkaline content. • Pretreatment to remove organic, chelating, or oil and grease contaminants may be required. <u>Sulfide Precipitation (Soluble Sulfide)</u> • Excess sulfide ions that are not precipitated remain in solution. They may be removed by using aeration to convert them from ionic to oxide form (sulfate). • pH control between 8 and 9.5 is required to avoid release of hydrogen sulfide gas. • Cost is high compared to hydroxide and carbonate precipitation <u>Sulfide Precipitation (Insoluble Sulfides)</u> • Ferrous sulfide is used in amounts greater than that required by stoichiometric considerations. • Produces more sludge than soluble sulfide or hydroxide processes.

Technology	Advantages	Limitations
Treatment Technologies for the Removal of Inorganic Contaminants (continued):		
Ion Exchange/ Adsorption	• High removal efficiencies for heavy metals. • Suitable for use as a polishing step after other technologies. • Technology is reasonably well understood. • On-site backflushing of exchange media allows immediate reuse.	• Resins are usually costly and may not be cost-effective for large treatment loadings. • Generates large volume of backflush solution (approximately 2.5 to 5% of the original ground-water flow rate) that is concentrated in the metals removed and requires treatment or disposal. • Requires bench-scale testing to determine operational requirements and suitability of prospective resins. • Beds can be fouled by particulate matter, oxidizing agents, oils, greases, biological growths, and intra-bed precipitates; therefore, pretreatment may be needed. • Resins may be irreversibly harmed by aromatics and certain other organic compounds; and by iron, manganese, and copper if enough dissolved oxygen is present. Pretreatment may be needed. • Spent resins require treatment before disposal.
Electro-chemical Methods	• High removal efficiencies for certain heavy metals. • Can treat both metals and cyanide simultaneously. • Technology is reasonably well understood. • Requires little floor space due to short residence time for hexavalent chromium reduction. • Requires minimal operator attention. • Low operating costs compared to chemical reduction or precipitation. • Requires no chemical addition.	• Particulate matter, oxidizing agents, oils, greases, biological growths may reduce process efficiency; therefore, pretreatment may be needed. • Hexavalent chromium reduction generates a heavy metal precipitate that must be removed from solution in a subsequent clarification or settling process. • A heavy metal sludge residual may be generated that may require treatment (dewatering and/or fixation) and that will require disposal. • A spent acid rinse solution may be generated that requires treatment or disposal. • Electrodes must be replaced occasionally.

NOTES:

[a] U.S. Environmental Protection Agency. 1991. Engineering Bulletin: *Air Stripping of Aqueous Solutions*. EPA/540/2-91/022. 8 pp.

[b] B. Lamarre. 1993. Selecting an air stripper (what to consider!) *The National Environmental Journal*: 26-29.

[c] G. M. Long. 1993. Clean up hydrocarbon contamination effectively. *Chemical Engineering Progress*: 58-66.

APPENDIX D

Descriptions of Presumptive Treatment Technologies

Appendix D1:	Air Stripping
Appendix D2:	Granular Activated Carbon
Appendix D3:	Chemical/UV Oxidation
Appendix D4:	Aerobic Biological Reactors
Appendix D5:	Chemical Precipitation
Appendix D6:	Ion Exchange/Adsorption
Appendix D7:	Electrochemical Methods
Appendix D8:	Aeration of Background Metals

Appendix D1: Air Stripping

Air stripping uses volatilization to transfer contaminants from ground water to air. In general, water is contacted with an air stream to volatilize dissolved contaminants into the air stream. Stripping of a specific chemical depends on the equilibrium vapor pressure of that chemical as expressed by its Henry's law constant.

Applicability

Air stripping is *applicable* to most of the volatile organic compounds (VOCs) as well as volatile inorganics such as ammonia and hydrogen sulfide. VOCs with high solubility in water (e.g., acetone) are more difficult to air strip. Air stripping is *potentially applicable* to certain halogenated semi-volatile organic compounds (SVOCs). It is *not applicable* to nonhalogenated SVOCs; heavy organics such as PCBs, dioxins/furans and pesticides; or inorganic metal compounds (U.S. EPA, 1991).

Air stripping is most effective for contaminants with a dimensionless (molar volume) Henry's law constant greater than 0.01 (or 2.4×10^{-4} atm-m^3/gmol at 25° C). (Henry's law constants are available in U.S. EPA [1990]). Removal efficiencies greater than 99 percent are difficult to achieve for certain compounds. In general, other treatment technologies will be required for such chemicals when ground-water concentrations are high (e.g., above 10,000 ppm or 1 percent).

Contaminant Fate

Contaminants are not destroyed by air stripping but are physically separated from contaminated ground water and transferred to air. Depending on the level of contaminants in the air discharge, the contaminated air stream may need further treatment. Additional polishing treatment of the aqueous effluent also may be necessary, depending on discharge requirements.

Design

Air strippers are designed for a specific target chemical (either the predominant contaminant or the most difficult-to-strip contaminant) with a desired target removal efficiency. The air stripping process is well understood and the technology is well developed. Air stripping has an extensive track record in a variety of applications.

The most frequently used configuration is a packed tower equipped with an air blower. The ground water is fed into the top of the stripper and the air is introduced at the bottom, creating a countercurrent gas-liquid contact. Random plastic packing is frequently used to improve gas-liquid contact. Structured packing and steel packing may also be used. Packed-tower air stripper design involves specification of stripper column diameter and packing height for a specified ground-water flow rate and air-to-water ratio. Shallow-tray aeration devices provide an alternative gas-liquid contacting system that provides a more compact, lower profile system that is less subject to fouling.

Alternative Techniques/Enhanced Methods

- For high flow rates (over 1,000 gpm), cooling towers (large structures with cascading water primarily used to cool water using countercurrent ambient air flow) may provide a cost-effective alternative to conventional packed towers.
- Shallow tray air strippers or diffused tank aeration units are less susceptible to fouling problems than packed towers and may be preferable where the water to be treated contains high concentrations of certain inorganics (e.g., iron).

Alternative Techniques/Enhanced Methods (continued)

- Because the efficiency of air stripping increases at higher temperatures, increasing the influent ground-water temperature (typically about 55° F) using a heat exchanger can increase the stripper's removal efficiency, especially for less volatile contaminants.
- Steam stripping methods, which use steam rather than air as the stripping medium, can be used to remove highly soluble contaminants and SVOCs not usually amenable to air stripping. However, operation costs for steam stripping can be two to three times greater than air stripping, depending on the cost of steam. In this guidance, these methods are not considered a type of air stripping and are not identified as a presumptive technology for ex-situ treatment of ground water.

Pre/Post-treatment

- Pretreatment to remove iron and other metals and to control hardness may be necessary to reduce fouling and mineral deposition in packed tower air strippers.
- Granular activated carbon is sometimes used to polish the treated water from an air stripper to further reduce organic contaminant levels and meet discharge requirements.
- Contaminants in the air discharge may be reduced by activated carbon adsorption, catalytic oxidation, or incineration to meet air emission requirements.

Selected References

Lamarre, B. 1993. Selecting an air stripper (what to consider!). The National Environmental Journal: 26-29.

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Nyer, E.K. 1993. Practical Techniques for Groundwater and Soil Remediation. CRC Press, Inc., Boca Raton, FL. 214 pp.

Okoniewski, B.A. 1992. Remove VOCs from wastewater by air stripping. Chemical Engineering Progress: 89-93.

U.S. EPA Environmental Protection Agency. 1990. Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) - Air Emission Models. EPA/450/3-87-026. Office of Air Quality Planning and Standards, Research Triangle Park, NC. Appendix D.

U.S. Environmental Protection Agency. 1991. Engineering Bulletin: Air Stripping of Aqueous Solutions. EPA/540/2-91/022. Office of Research and Development, Cincinnati, OH. 9 pp.

Appendix D2: Granular Activated Carbon

Activated carbon removes contaminants from ground water by adsorption. The adsorption process takes place in three steps: (1) contaminant migration to the external sorbent surface; (2) diffusion into the sorbent pore structure; and (3) adsorption onto the sorbent surface. The principal form of activated carbon used for ground-water treatment is granular activated carbon (GAC). GAC is an excellent sorbent due to its large surface area, which generally ranges from 500 to 2,000 m^2/g.

Applicability

GAC is *applicable* to a wide variety of contaminants including: halogenated volatile and semivolatile organics, nonhalogenated volatile and semivolatile organics, PCBs, pesticides, dioxins/furans, most organic corrosives, metals, radioactive materials, inorganic cyanides, and certain oxidizers. GAC is *potentially applicable* to certain organic cyanides, and it is *not applicable* to asbestos, inorganic corrosives, and reducers (U.S. EPA, 1991). GAC is sometimes used alone for ground-water treatment. However, GAC is typically used for polishing aqueous effluents or controlling air emissions from other treatment technologies.

The adsorption capacity of activated carbon varies for specific organic compounds and for different types of GAC (based on the origin of coal and the percent binder used in the manufacture of the GAC). Contaminant-specific adsorption isotherms for a given type of GAC are generally available from the carbon manufacturer.

Contaminant Fate

Contaminants are not destroyed by carbon adsorption, but are physically separated from contaminated water and transferred to carbon. After exhaustion, the spent carbon may be reactivated, regenerated, incinerated, or disposed of. Thermal reactivation and incineration destroy most or all adsorbed organic contaminants. Steam or hot gas regeneration is not appropriate for spent GAC from treatment of contaminated ground water but can be used for spent GAC from air emission control devices. GAC used for metals sorption may require disposal. If disposed of, spent GAC may have to be managed as a hazardous waste.

Design

Activated carbon is a well-developed, widely used technology with many successful ground-water treatment applications, especially for secondary polishing of effluents from other treatment technologies. Contaminated ground water is contacted with a fixed GAC bed in a vessel. Flow direction is generally vertically downward, although an upward flow configuration is also possible. Fixed-bed configurations are also used for air emission control.

Adsorber design involves determining total carbon requirements and the number and dimensions of vessels needed to house the carbon. The amount of carbon required for a given application depends on the loading of adsorbable constituents in ground water (or contaminated air stream), the carbon's adsorption capacity for these constituents, and the carbon reactivation (or regeneration) frequency. Depending on the ground-water suspended solids content, it may be necessary to periodically backwash down flow carbon beds to relieve pressure drop associated with solids accumulation.

Alternative Techniques/Enhanced Methods

- Staged bed (multiple beds operated in series) and pulsed bed (carbon beds operated with nearly continuous "pulsed" addition of fresh carbon and withdrawal of spent carbon) designs can be used if higher removal efficiencies are required.

Alternative Techniques/Enhanced Methods (continued)

- Because the adsorption capacity of GAC is much higher for gas phase treatment than for liquid phase treatment, it is often more economical to use an air stripper followed by gas phase GAC to treat the air stripper exhaust than to use GAC alone for ground-water treatment.

- **GAC is not identified as a presumptive technology for removal of metals dissolved extracted ground water. Spent carbon used for metals removal can be difficult to regenerate and may require treatment and/or disposal as a hazardous waste.** Although GAC can remove low concentrations of certain metals, it has not been widely used for this purpose (U.S. EPA, 1991).

Pre/Post-treatment

- Pretreatment may be required to remove natural organic matter, such as fulvic and humic acids, that may interfere with the adsorption of the target contaminants or rapidly exhaust the GAC.
- Naturally occurring **radionuclides**, if present in ground water, can accumulate in the GAC during treatment, **which could result in potential exposure hazards for operating personnel and the spent carbon may require treatment and/or disposal as hazardous waste**.

- Thermal reactivation, using heat alone or steam, is typically used as a post-treatment method for the spent carbon. The carbon is reactivated in a high-temperature reactor under reducing conditions. Most organic contaminants are thermally degraded during the reactivation process.

Selected References

Long, G.M. 1993. Clean up hydrocarbon contamination effectively. *Chemical Engineering Progress*, 89(5):58-67.

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U.S. Environmental Protection Agency. 1991. *Engineering Bulletin: Granular Activated Carbon Treatment*. EPA/540/2-91/024. Office of Emergency and Remedial Response, Washington, D.C. 8 pp.

Appendix D3: Chemical/UV Oxidation

Chemical oxidation uses chemical oxidizing agents to destroy toxic organic chemicals and cyanide compounds (CN) in ground water. Commonly used oxidizing agents include: ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. Ozone and hydrogen peroxide are generally preferred for removing organics and CN from ground water because chlorine-based oxidants can produce toxic byproducts (e.g., HCl, chlorinated organics). Ultraviolet light (UV) is often used in conjunction with ozone and/or hydrogen peroxide to promote faster and more complete destruction of organic compounds (reaction rates may be increased by factors of 100 to 1,000).

Applicability

Chemical oxidation is *applicable* to both volatile and semivolatile organic compounds and cyanide compounds. Chemical oxidation is *potentially applicable* to PCBs, dioxins/furans, and metals (oxidation can be used to precipitate metals under certain conditions). Chemical oxidation is *not applicable* to asbestos and radioactive materials (U.S. EPA, 1991).

Chemical oxidation generally is effective for concentrations less than 500 µgL, but has been used for certain compounds at concentrations ranging up to several thousand mg/L. UV can enhance the oxidation of compounds that are resistant to chemical oxidation alone (e.g., PCBs). Iron or copper catalysts may be required for efficient destruction of certain organic compounds (e.g., phenols).

Contaminant Fate

Complete oxidation decomposes hydrocarbons into carbon dioxide and water, although chlorinated organic compounds also yield chloride ions. CN is oxidized to ammonia and bicarbonate by hydrogen peroxide in an alkaline environment. If oxidation is incomplete, toxic constituents may remain, or intermediate degradation products can be formed that may be toxic. These toxic substances may be removed using GAC as a secondary or polishing treatment step.

Design

Chemical oxidation is a proven and effective technology that is carried out in either batch or continuous reactors. Oxidants are generally added to contaminated ground water in a mixing tank prior to introduction into the reaction vessel (reactor). The use of ozone as the oxidizing agent requires an onsite ozone generator and an ozone decomposition unit or other ozone emission control device. The use of hydrogen peroxide as the oxidizing agent requires storage tanks and special handling protocols to ensure operator safety. The use of chlorine as the oxidizing agent may produce HCl gas. If HCl is produced, an acid gas removal system may be necessary.

UV lamps, if used, are typically enclosed in quartz tubes submerged inside the reaction vessel. The tubes are subject to fouling or scaling from compounds such as iron oxide or calcium carbonate and from biological flocs from microorganisms in ground water. If fouling occurs, oxidation rates are drastically reduced.

Site-specific treatability studies are generally recommended for chemical oxidation systems. Extensive pretreatment may be required to condition ground water for effective oxidation. If UV lamps are used, the studies must evaluate the potential for fouling or scaling of the quartz tubes at the ground-water composition, oxidant concentration, and UV intensity conditions anticipated for long-term system operation. If fouling or scaling is likely, pretreatment and/or physical methods for keeping the tubes clean (e.g., wipers) may be required. If metals are to be removed by oxidation, solids should be removed by clarification or filtration prior to UV oxidation. Provisions for removing precipitated metal sludges also may be necessary.

Alternative Techniques/Enhanced Methods

- UV radiation can be used in combination with a chemical oxidizing agent to increase the effectiveness of oxidation, especially for difficult-to-oxidize compounds.
- Metal catalysts, such as iron or copper, can be used in combination with a chemical oxidizing agent to increase the effectiveness of oxidation for certain types of compounds.
- Hydrodynamic cavitation is an innovative technology recently demonstrated under EPA's SITE program that uses forced cavitation of gas to enhance destruction of organics during UV oxidation processes.

Pre/Post-treatment

- Pretreatment may be necessary to remove solids, microorganisms, calcium carbonate, iron oxides, and/or other metals that can interfere with the oxidation process or UV transmission. A pretreatment sequence of precipitation, flocculation, clarification, and/or filtration steps may be necessary.
- Post-treatment of the aqueous effluent with GAC may be necessary if destruction is not complete or if toxic byproducts are formed during oxidation.
- If toxic metals precipitate during the oxidation process, treatment and/or proper disposal of the resulting sludge may be required.

Selected References

U.S. Environmental Protection Agency. 1990. *CERCLA Site Discharges to POTWs Treatability Manual.* EPA/540/2-90/008. Office of Emergency and Remedial Response. PB91-921269/CCE. NTIS. Springfield, VA. pp. 11-7 to 11-17.

U.S. Environmental Protection Agency. 1991. *Engineering Bulletin: Chemical Oxidation Treatment.* EPA/540/2-91/025. Office of Emergency and Remedial Response, Washington, D.C. 8 pp.

U.S. Environmental Protection Agency. 1993. *Superfund Innovative Technology Evaluation Program. Technology Profiles. Sixth Edition.* EPA/540/R-93/526. Office of Research and Development, Washington, DC.

U.S. Navy. 1993. *UV/Oxidation Treatment of Organics in Ground Water.* NEESA Document Number 20.2-051.7. Navy Energy and Environment Support Activity, Port Hueneme, CA. 11 pp.

Appendix D4: Aerobic Biological Reactors

Biological reactors use microorganisms to degrade organic contaminants in ground water in ex situ reactors. There are two basic types of ex situ biological treatment processes: aerobic reactors and anaerobic reactors. Aerobic reactors use oxygen to promote biodegradation and are widely used. Anaerobic reactors degrade organics in the absence of oxygen. This guidance focuses on aerobic biological treatment because anaerobic treatment processes are not widely used for ground-water treatment.

Applicability

Aerobic biological reactors are *applicable* to a wide variety of halogenated and nonhalogenated volatile and semivolatile organics. Aerobic biological reactors are *potentially applicable* to heavy organics, such as PCBs and certain pesticides, and organic and inorganic cyanides, but are generally not as effective for such recalcitrant compounds. Aerobic processes are *not applicable* to metals, asbestos, radioactive materials, or corrosive or reactive chemicals (U.S. EPA, 1992).

Contaminant Fate

Organic compounds are decomposed to carbon dioxide and water (aerobic processes) or to methane and carbon dioxide (anaerobic processes). Volatile organics are also removed by volatilization as a competing mechanism. Microbial growth produces an excess organic sludge (biomass) that must be disposed of properly. This sludge may concentrate metals and recalcitrant organic compounds that are resistant to degradation. Biodegradation may produce decomposition byproducts that are emitted to the air or dissolved in the effluent, and these decomposition byproducts may require additional treatment.

Design

Ex situ biological treatment of ground water is conducted in bioreactors. The primary factors influencing bioreactor design are the microbial organic utilization rates and the peak organic loading rate (i.e., flow rate times organic concentration). Treatability tests are necessary to determine these and other design parameters. Under most circumstances, bioreactors require a significant startup time to acclimate the microorganisms to the specific contaminants being treated before the bioreactor will operate at optimal degradation rates. There are two general types of bioreactor design:

- In **suspended growth** reactors, microbes are kept suspended in water using mechanical aerators or diffused air systems. These aeration systems also keep the solution well mixed, improving contact between microbes and dissolved contaminants and supplying oxygen to the system. Activated sludge systems are the most common suspended growth bioreactors. Other examples include aerated ponds or lagoons, stabilization ponds (using both algae and bacteria), and sequencing batch reactors.
- In **attached growth** reactors, biomass is attached to a solid substrate, such as sand, rock, plastic, activated carbon, or resin. Reactor design is dependent upon the surface area of substrate media available for biomass growth. Examples include trickling filter, rotating biological contactor, fluidized bed, fixed bed, and roughing filter designs.

Alternative Techniques/Enhanced Methods

- Direct addition of powdered activated carbon (PAC) into suspended growth bioreactors can both improve removal efficiency and reduce the likelihood of process upsets by buffering the concentrations of toxic compounds at levels amenable to biodegradation.

Alternative Techniques/Enhanced Methods (continued)

- Microbial augmentation (the addition of specially cultured microorganisms) may be used to increase the system's removal efficiency for certain difficult-to-degrade contaminants.
- Anaerobic reactors (digesters) may be preferred for the treatment of certain ground-water contaminants (e.g., certain chlorinated organics) that are difficult to degrade aerobically. **However, anaerobic reactors have not been identified as a presumptive technology for the following reasons**: 1) anaerobic processes have not been widely used for ground-water treatment; 2) reaction rates are slower than for aerobic processes, which result in longer startup times (for acclimation) and longer treatment times; and 3) such reactors have a greater sensitivity to process upsets, especially where flow and contaminant concentrations vary over time. These factors generally result in higher operation and maintenance requirements and costs, and lower performance efficiencies than for aerobic processes in ground-water applications.

Pre/Post-treatment

- Chemical precipitation (for metals) or other pretreatment (e.g., PAC addition for organics) may be required to reduce (or buffer) concentrations of compounds that are toxic to microorganisms.
- Carbon adsorption post-treatment may be used to reduce contaminant concentrations in the treated water to meet discharge requirements.
- Because certain aerated bioreactor designs (e.g., mechanically aerated activated sludge systems, aerated ponds and lagoons) present difficulties for direct capture and control of air emissions, an air stripper (with emission controls) may be a cost-effective treatment prior to biodegradation if volatile contaminant emissions need to be controlled. For other bioreactor designs, such as diffused-aeration activated sludge and trickling filter systems, air emissions are more easily captured and can be treated using carbon adsorption, catalytic oxidation, or incineration.

Selected References

Eckenfelder, W.W., J. Patoczka, and A.T. Watkins. 1985. Wastewater treatment. *Chemical Engineering*: 60-74.

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U.S. Environmental Protection Agency. 1979. *Selected Biodegradation Techniques for Treatment and/or Ultimate Disposal of Organic Materials*. EPA-600/2-79-006. Office of Research and Development, Cincinnati, OH.

U.S. Environmental Protection Agency. 1981. *Literature Study of the Biodegradability of Chemicals in Water (Volume 1. Biodegradability Prediction, Advances in and Chemical Interferences with Wastewater Treatment)*. EPA/R806699-01. Office of Research and Development, Cincinnati, OH.

U.S. Environmental Protection Agency. 1992. *Engineering Bulletin: Rotating Biological Contactors*. EPA/540/S-92/007. Office of Research and Development, Cincinnati, OH. 8 pp.

Appendix D5: Chemical Precipitation

Chemical precipitation chemically converts dissolved metal and/or other inorganic ions in ground water into an insoluble form, or precipitate. Metal ions generally precipitate out as hydroxides, sulfides, or carbonates and are removed as solids through clarification and filtration. In this guidance, chemical precipitation is defined to include chemical precipitation of metals by oxidizing or reducing agents, as well as any pH adjustment (neutralization) and solids removal steps required.

Applicability

Chemical precipitation is *applicable* to dissolved metal and other inorganic ions (such as arsenate and phosphate). Chemical precipitation is *not applicable* to volatile or semivolatile organic compounds (U.S. Navy, 1993).

Contaminant Fate

Dissolved metals are converted to insoluble forms, which are subsequently removed by flocculation, clarification, and/or filtration. The solid residue (chemical sludge) containing the metal contaminant then must be treated and/or disposed of properly.

Design

The process generally takes place at ambient temperatures. Batch reactors are generally favored for lower flowrates (e.g., up to about 50,000 gpd), and usually use two tanks operating in parallel. Each tank can act as a flow equalizer, reactor, and settler, thus eliminating separate equipment for these steps. Continuous systems have a chemical feeder, flash mixer, flocculator, settling unit, filtration system (if used), and control system for feed regulation. Site-specific treatability tests are required to determine the optimum type and dosage of precipitation chemicals, necessary pretreatment steps, and post-treatment requirements for aqueous effluent and sludge residuals.

There are three types of precipitation chemicals:

- **Metal hydroxides** are formed by the addition of alkaline reagents (lime or sodium hydroxide). Precipitation is then initiated by adjusting pH to the optimum level for the particular metal ion. Maintaining pH levels within a relatively narrow optimum range is usually necessary to achieve adequate metal precipitation. Pretreatment with oxidizing or reducing chemicals (e.g., hydrogen peroxide, ferrous sulfate) may be necessary to precipitate some metals (e.g., iron, manganese, chromium) in their least soluble form. Natural organic matter can inhibit the formation of insoluble metal hydroxides by forming metal-organic complexes. Metal hydroxide precipitation is typically effective for arsenic, cadmium, chromium (+3), nickel, zinc, manganese, copper (+2), tin (+3), and iron (+3).

- **Metal sulfides** are formed by the addition of either soluble sulfides (e.g., hydrogen sulfide, sodium sulfide, or sodium bisulfide) insoluble sulfides (e.g., ferrous sulfide). Sodium sulfide and sodium bisulfide are most commonly used. Sulfur dioxide and sulfur metabisulfite have also been demonstrated for chromium reduction prior to precipitation. Metal sulfides have lower solubilities than metal hydroxides, and effective metal removal efficiencies can be achieved over a broader pH range. The method is mainly used to remove mercury and lead and may be used to remove arsenic, cadmium, chromium (+3,or +6), silver and others. Sulfide precipitation also can be used to treat filtered ground water after hydroxide precipitation.

Appendix D5: Chemical Precipitation (continued)

Alternative Techniques/Enhanced Methods

- **Metal carbonates** are formed by the addition of calcium carbonate or by adding carbon dioxide to metal hydroxides. Solubilities of metal carbonates are intermediate between the solubilities of metal hydroxides and metal sulfides. Insoluble metal carbonates are easily filtered from treated ground water. The method is particularly good for precipitating lead, cadmium, and antimony.

- Sodium xanthate has shown promise as a precipitation agent similar to sodium sulfide.

Pre/Post-treatment

- Pretreatment to adjust pH is normally required to obtain the lowest precipitate solubility.
- Pretreatment may be necessary to oxidize iron or manganese compounds or reduce hexavalent chromium compounds into forms that can be readily precipitated.
- Depending on discharge requirements, the aqueous effluent may need pH adjustment and/or further polishing. Activated alumina or ion exchange media are regenerable treatment options for effluent polishing for metals. Activated carbon also may be used but spent carbon may require treatment and disposal as a hazardous waste.
- The sludge may require stabilization treatment by addition of lime/fly ash or portland cement to reduce permeability and the leachability of metals prior to disposal. In some cases, metals may be recovered from the residue for reuse, but this is generally not economical.

Selected References

Monopoli, A.V. 1993. Removing dissolved inorganics from industrial wastewater. *The National Environmental Journal:* 52-56.

U.S. Environmental Protection Agency. 1987. *Handbook on Treatment of Hazardous Waste Leachate.* EPA/600/8-87/006. Office of Research and Development, Cincinnati, OH. pp. 44-45.

U.S. Environmental Protection Agency. 1990. *CERCLA Site Discharges to POTWs Treatability Manual.* EPA/540/2-90/008. Office of Emergency and Remedial Response. PB91-921269/CCE. NTIS, Springfield, VA. pp. 11-23 to 11-36.

U.S. Navy. 1993. *Precipitation of Metals from Ground Water.* NEESA Document Number 20.2-051.6. Navy Energy and Environment Support Activity. Port Hueneme, CA. 11 pp.

Appendix D6: Ion Exchange/Adsorption

Ion exchange removes metal contaminants from water by passing contaminated ground water through a granular solid or other porous material, usually an impregnated resin, that exchanges sorbed ions (e.g., H^+, OH^-, Na^+, Li^+, CO_3^{--}) for contaminants dissolved in ground water. The ion exchange media are selected to have sorptive affinity for the ionic forms (cation or anion) of the contaminants being removed. The ion exchange media can therefore be either cationic, anionic, or a mixture of the two. Because ion exchange is a reversible process, resins can be regenerated by backwashing with a regeneration solution (e.g., brine; strong or weak acids or bases). Conventional ion exchange resins are generally too costly for large-scale ground-water treatment and are predominantly used for polishing of aqueous effluents after other treatment processes.

Applicability

Ion exchange is *applicable* to ionic contaminants such as dissolved metals or nitrates. Ion exchange is *not applicable* to non-ionic contaminants such as most organic compounds.

Contaminant Fate

Contaminants are removed from ground water through sorption onto the exchange media. When most of the exchange sites of the media become filled, the exchange media are regenerated by backflushing with a suitable regeneration solution. The concentrated backflush solution must then be disposed of or stripped of its contaminants. Exchange resins can generally be regenerated many times and have a relatively long useful life.

Design

Various resin types are available to tailor systems to discrete ionic mixes. For example, acid exchangers replace cations in water with hydrogen ions and base exchangers replace anions with hydroxide ions. Weak acid and base exchangers are selective for more easily removed ions while strong acid and base exchangers are less selective, removing most ions in the ground water. Generally, ease of cation and anion removal follows an affinity sequence specific to the ions in question. Synthetic resins are available with unique selectivity sequences. The wide variety of resins and other ion exchange media (e.g., activated alumina, biological materials) that are available make the selection of an appropriate exchange media a critical design step. Information on the applicability of specific resins may be obtained from resin manufacturers. In addition, ion exchange resins generally have an optimum pH range for effective metals removal. pH control may be required to achieve maximum removal efficiency from ground water.

A typical ion exchange installation has two fixed beds of resin. While one is in operation, the other is regenerated. Batch, fixed column, and continuous column bed designs can be used. Downflow column designs are generally preferred. Continuous column systems eliminate the need for backwashing but are not commonly used because of the complexity of the resin removal mechanics.

Flow rates up to 7,000 gpm have been reported for ion exchange systems. However, conventional ion exchange is generally cost-effective for ground-water treatment only at low flow rates or low contaminant concentrations. It is therefore primarily used as a polishing step following chemical precipitation or other treatment.

Appendix D6: Ion Exchange/Adsorption (continued)

Alternative Techniques/Enhanced Methods

- Activated alumina is an anionic exchange medium comprised of granulated, dehydrated aluminum hydroxide. Activated alumina is effective for removing fluoride, selenium, chromium (+6), and arsenic ions, which are exchanged for hydroxide ions. Adjustment of pH may be necessary to achieve optimal removal efficiency. The alumina is regenerated with a sodium hydroxide solution.
- Biological materials (e.g., algae, crop residues) have recently shown great promise as an innovative ion exchange media for metals. Biological media are significantly less costly than conventional resins (cents per pound vs. dollars per pound), and may become more commonly used for metals removal from ground water.
- Electrodialysis uses alternately placed cation and anion permeable membranes (made of ion exchange resin) and an electrical potential to separate or concentrate ionic species.
- Activated carbon adsorption can also be used to remove inorganics at low concentrations. **However, activated carbon is not identified as a presumptive technology for removal of metals dissolved extracted ground water.** Spent carbon used for metals removal can be difficult to regenerate and may require treatment and/or disposal as a hazardous waste.

Pre/Post-treatment

- Pretreatment may be required to remove suspended solids at concentrations greater than about 25 mg/L or oil at concentrations greater than about 20 mg/L. Large organic molecules also can clog resin pores and may need to be removed.
- pH adjustment may be necessary to achieve optimal metals removal.
- The backwash regeneration solution must be treated to remove contaminants.
- Post-treatment of spent ion exchange media may be required to recover concentrated contaminants or management as a hazardous waste may be required.

Selected References

Clifford, D., Subramonian, S., and Sorg, T.J., 1986. "Removing Dissolved Inorganic Contaminants from Water," *Environmental Science and Technology*, Vol. 20, No. 11.

Nyer, E.K. 1985. *Groundwater Treatment Technologies.* Van Nostrand Reinhold. New York, NY. 187 pp.

U.S. Environmental Protection Agency. 1990. *CERCLA Site Discharges to POTWs Treatability Manual.* EPA/540/2-90/008. Office of Emergency and Remedial Response. PB91-921269/CCE. NTIS. Springfield, VA. pp. 11-102 to 11-112.

Appendix D7: Electrochemical Methods

Electrochemical processes use direct electrical current applied between two immersed electrodes to drive chemical oxidation-reduction reactions in an aqueous solution. Historically, electrochemical processes have been used to purify crude metals or to recover precious metals from aqueous solutions. Positively charged metal ions are attracted to the negatively charged electrode (the cathode), where they are reduced. The reduced metals typically form a metallic deposit on the cathode. Negatively charged ions are attracted to the positively charged electrode (the anode), where they are oxidized.

For contaminated ground water treatment, electrochemical cells have been used for the reduction (and subsequent precipitation) of hexavalent chromium to trivalent chromium. In this process, consumable iron electrodes are used to produce ferrous ions (Fe^{2+}) at the anode and hydroxide ions (OH^-) at the cathode. An oxidation-reduction reaction then occurs between the ferrous, chromium, and hydroxide ions to produce ferric hydroxide $Fe(OH)_3$ and chromic hydroxide $Cr(OH)_3$, which subsequently precipitate from solution.

Applicability

Electrochemical processes are *applicable* to dissolved metals. It is most commonly used in ground water treatment for the reduction and precipitation of hexavalent chromium. The process also may be applicable to removing other heavy metals including arsenic, cadmium, molybdenum, aluminum, zinc, and copper ions. Electrochemical processes have also been used for the oxidation of cyanide wastes (at concentrations up to 10 percent). Electrochemical processes are *not applicable* to organic compounds or asbestos.

Contaminant Fate

Dissolved metals either deposit on the cathode or precipitate from solution. Precipitates form an inorganic sludge that must be treated and/or disposed of, typically in a landfill. Spent acid solution, which is used to periodically remove deposits formed on the electrodes, will also require proper treatment and disposal. Cyanide ions are hydrolyzed at the anode to produce ammonia, urea, and carbon dioxide.

Design

Electrochemical reactors generally operate at ambient temperatures and neutral pHs. Both batch reactors and continuous flow reactors are commercially available. A typical electrochemical cell for hexavalent chromium reduction consists of a tank, consumable iron electrodes, and a direct current electrical supply system. An acid solution is used to periodically clean the iron electrodes, which need to be replaced when they are significantly consumed. Reactor residence times required for treatment depend on the contaminants present as well as the degree of mixing and current density. Reduction of hexavalent chromium generally requires short residence times (approximately 10 seconds), whereas treatment of cyanide compounds requires longer process times.

Pre/Post-treatment

- Pretreatment may be necessary to remove suspended solids.
- Settling or clarification post-treatment may be necessary to remove the precipitated trivalent chromic and ferric hydroxides formed during hexavalent chromium electrochemical reduction.

Pre/Post-treatment (continued)

- The sludge may require stabilization prior to disposal by addition of lime/fly ash or portland cement to reduce permeability and metal leachability. In some cases, metals may be recovered from the plated electrode or precipitated residue, but this is generally not economical for typical ground-water applications.

Selected References

Englund, H.M. and L. F. Mafrica. 1987. *Treatment Technologies for Hazardous Waste.* APCA Reprint Series RS-13. Air Pollution Control Association, Pittsburgh, PA. pp. 43-44.

U.S. Environmental Protection Agency. 1990. *A Compendium of Technologies Used in the Treatment of Hazardous Wastes.* EPA/625/8-87/014. Office of Research and Development. PB91-90-274093. NTIS. Springfield, VA. p. 23.

Appendix D8: Aeration of Background Metals

Aeration (contact with air) removes some metals from water by promoting chemical oxidation and the formation of insoluble hydroxides that precipitate from the water. Aeration for metals removal differs from air stripping in that precipitation rather than volatilization is the desired effect of the technology.

Applicability

Aeration techniques are useful for the removal of limited number of dissolved cations and soluble metal compounds. This method is well suited for the removal of background metals such as iron and manganese which is necessary as part of a selected remedy such as pretreatment to air stripping. Methods of aeration for metals include aeration tanks, aeration basins, or cascade aeration. Aeration methods are usually not sufficient as an independent technology for iron and manganese, but are utilized as a step in the treatment process. Often, the air-water contact in tank and cascade aeration is not enough to obtain high removal efficiencies. Spray basins are limited by area, wind, and ice particle formation (Nyer, 1985).

Contaminant Fate

Dissolved metals are oxidized to insoluble hydroxides which precipitate from solution, and can then can be subsequently removed by flocculation, sedimentation, and/or filtration.

Design

The three types of aeration systems:

- Aeration tanks bubble compressed air through a tank of water.
- Cascade aeration occurs when air is made by turbulent flow and agitation.
- Spray or aeration basins use an earthen or concrete basin with a piping grid and spray nozzles that spray the water into the air in very fine droplets.

Related methods include aeration used to remove volatile organic contaminants from water are considered to be a type of air stripping, as discussed in Section 2.1.1. The use of aeration to promote aerobic biological treatment processes is considered to be an element of biological treatment as discussed in Section 2.1.4.

Pre/Post Treatment

- Aeration is often a pretreatment for other remediation technologies, such as air stripping, to remove certain metals.
- Aeration can be followed by other treatments such as flocculation, sedimentation, and/or filtration to remove oxidized metals.

Appendix F:
NJDEP Effluent Standards

This is a courtesy copy of this rule. All of the Department's rules are compiled in Title 7 of the New Jersey Administrative Code.

Subchapter 12. Effluent Standards Applicable to Direct Discharges to Surface Water and Indirect Discharges to Domestic Treatment Works

7:14A-12.1 Purpose and Scope

(a) This subchapter specifies Federal and State effluent standards which may be incorporated into a permit as an effluent limitation for direct discharges to surface water including those discharges conveyed to surface water via storm sewers and indirect discharges to DTWs.

(b) The effluent standards contained in this subchapter are applicable as follows:

1. Regarding stormwater discharges:

i. Any discharge of stormwater authorized by a general permit is exempt from the requirements of this subchapter unless such general permit provides otherwise;

ii. Any stormwater discharge shall be subject to one or more requirements of this subchapter when the effluent standard in question is achievable by stormwater treatment processes using commercially available technology and is not achievable using other practicable BMPs, and the fact sheet or statement of basis for the draft permit provides the basis for the inclusion of such requirement(s).

2. Regarding discharges from combined sewer overflows:

i. Any discharge from a combined sewer overflow authorized by a general permit is exempt from the requirements of this subchapter unless such general permit provides otherwise:

ii. Any discharge from a combined sewer overflow shall be subject to one or more requirements of this subchapter when the fact sheet for the draft permit for such discharge provides the basis for the inclusion of such requirement(s).

3. Any discharge other than those identified at (b)1. above shall be exempt from one or more of the requirements in this subchapter as specified in the applicable section.

4. Any discharge of a parameter to which this subchapter applies that is also regulated by another regulatory agency shall meet the more stringent standards of such agency or of this subchapter.

7:14A-12.2 Secondary Treatment Effluent Standards

(a) The requirements of this section shall apply to all direct discharges to surface water from publicly or privately owned domestic treatment works included in a NJPDES permit.

(b) The minimum level of effluent quality attainable by secondary treatment in terms of the parameter BOD_5, except as provided for in N.J.A.C. 7:14A-12.3 is as follows:

1. The monthly average value shall not exceed 30 mg/L;

2. The weekly average value shall not exceed 45 mg/L; and

3. The monthly average value for percent removal shall not be less than 85 percent.

(c) In lieu of the parameter BOD_5 and the levels of the effluent quality specified in (b) above, the parameter $CBOD_5$ may be substituted as follows:

1. The monthly average value shall not exceed 25 mg/L;

2. The weekly average value shall not exceed 40 mg/L; and

3. The monthly average value for percent removal shall not be less than 85 percent.

(d) Chemical oxygen demand COD or total organic carbon (TOC) may be substituted for BOD5 or CBOD5 when a long-term BOD5 or CBOD5:COD or BOD5 or CBOD5:TOC correlation is demonstrated whereby a permittee submits data which indicates that a different BOD5 or CBOD5:COD or BOD5 or CBOD5:TOC ratio would be more appropriate. In the absence of data to establish a long term correlation, the BOD5:COD ratio shall be assumed to be 1:2 and the BOD5:TOC ratio shall be assumed to be 1:1.

(e) The minimum level of effluent quality attainable by secondary treatment in terms of the parameter TSS, except as provided in N.J.A.C. 7:14A-12.3 is as follows:

1. The monthly average value shall not exceed 30 mg/L;

2. The weekly average value shall not exceed 45 mg/L; and

3. The monthly average value for percent removal shall not be less than 85 percent.

(f) The pH shall be maintained within the limits of 6.0 to 9.0 standard units unless the facility demonstrates that:

1. Inorganic chemicals are not added to the wastestream as part of the treatment process; and

2. Contributions from industrial sources do not cause the pH of the effluent to be less than 6.0 or greater than 9.0.

7:14A-12.3 Secondary Treatment Special Considerations

(a) This section identifies special considerations applicable to effluent limitations for BOD_5 or $CBOD_5$ and TSS percentage removal or, for facilities receiving waste from certain industrial categories, relief in terms of less stringent BOD_5 or $CBOD_5$ and TSS concentration levels when the level of treatment required is more stringent than the minimum treatment requirements specified in N.J.A.C. 7:14A-12.2.

(b) For domestic treatment works receiving less concentrated influent wastewater from combined sewer systems during wet weather, the Department may remove, or impose a less stringent, BOD_5 or $CBOD_5$ and TSS percent removal requirement than specified in N.J.A.C. 7:14A-12.2(b)3, (c)3 or (e)3. For such treatment works, any attainable percentage removal level shall be defined on a case-by-case basis.

(c) For domestic treatment works receiving less concentrated influent wastewater from combined sewer systems during dry weather, the Department shall remove, or impose a less stringent, BOD_5 or $CBOD_5$ and TSS percent removal requirement than specified in N.J.A.C. 7:14A-12.2(b)3, (c)3 or (e)3 if the permittee satisfactorily demonstrates that:

1. The treatment works is consistently meeting, or will consistently meet its permit effluent concentration limits, but the percent removal requirements cannot be met due to less concentrated influent wastewater. In such case an applicant shall demonstrate compliance with effluent limitations consistently achievable through proper operations and maintenance, as defined in N.J.A.C. 7:14A-1.2; and

2. To meet the percent removal requirements, the treatment works would have to achieve significantly more stringent effluent limitations, as defined in N.J.A.C. 7:14A-1.2, than would otherwise be required by the concentration-based standards and associated loadings; and

3. The less concentrated influent wastewater does not result from either excessive infiltration or clear water industrial discharges (for example, non-contact cooling water discharges or other discharges which do not contain pollutants in sufficient quantities to otherwise be of concern) during dry weather periods. If the less concentrated influent wastewater is the result of clear water industrial discharges, then the treatment works must control such discharges in accordance with 40 CFR 403.

(d) For domestic treatment works receiving less concentrated influent wastewater from a separate sewer system, the Department shall remove, or impose a less stringent, BOD_5 or $CBOD_5$ and TSS percent removal requirement than specified in N.J.A.C. 7:14A-12.2(b)3, (c)3 or (e)3, if the permittee satisfactorily demonstrates that:

1. The treatment works is consistently meeting, or will consistently meet, its permit effluent concentration limits but the percent removal requirements cannot be met due to less concentrated influent wastewater. In such case an applicant shall demonstrate compliance with effluent limitations consistently achievable through proper operations and maintenance as defined in N.J.A.C. 7:14A-1.2; and

2. To meet the percent removal requirements, the treatment works would have to achieve significantly more stringent limitations as defined in N.J.A.C. 7:14A-1.2, than would otherwise be required by the concentration-based standards; and

3. The less concentrated influent wastewater is not the result of excessive inflow/infiltration.

(e) For domestic treatment works receiving industrial waste from certain industrial categories, the average monthly values for BOD_5, or $CBOD_5$ and TSS specified in N.J.A.C. 7:14A-12.2(b)1, (c)1 or (e)1 shall be made less stringent provided that:

1. The permitted discharge of BOD_5 or $CBOD_5$ and TSS from the domestic treatment works, attributable to the industrial category, would not be greater than that which would be permitted under sections 301(b)(1)(A)(i), 301(b)(2)(E) or 306 of the Federal Act if such industrial category were to discharge directly to surface water; and

2. The flow or loading for BOD_5 or $CBOD_5$ and TSS introduced to the domestic treatment works by the industrial category exceeds 10 percent of the design flow or loading of the domestic treatment works. When such an adjustment is made, the weekly average value for BOD_5 or $CBOD_5$ and TSS specified in N.J.A.C. 7:14A-12.2(b)2, (c)2 or (e)2 shall be adjusted proportionately.

(f) When requesting special consideration for any of the discharges described in (b), (c) and (d) above, an applicant shall submit, as part of the request, all demonstrations specified in the applicable subsection and, in addition, the following:

1. The BOD_5, or $CBOD_5$, and TSS percent removal requested, as applicable, and whether the request is for seasonal or year round relief;

2. If the discharge is also regulated by another regulatory agency (for example, Delaware River Basin Commission, Interstate Environmental Commission), a brief written statement from that regulatory agency that the agency has no objection to the request for special consideration;

3. At a minimum, 24 consecutive months of influent and effluent data sampled at monthly intervals for BOD5 or CBOD5 and TSS concentration, as well as percentage removal, presented in summary form. Pollutant data for BOD5 or CBOD5 and TSS shall be sampled in accordance with the methods and procedures described in the applicable permit. Data collected during periods of upsets, bypasses, operational errors or other unusual conditions shall be excluded. The data shall contain, at a minimum, the following information:

   i. Parameter value in mg/L for influent (concentration only) and effluent (concentration and percent removal);

   ii. Date on which each sample was taken;

   iii. Effluent flow at time of each sample;

   iv. Weather conditions at time of each sampling (for example, raining or dry);

   v. Total population served; and

vi. The total amount of flow attributable to major industrial and commercial users contributing greater than 50,000 gallons per day each.

4. All permit limit exceedences;

5. For combined sewer systems only, the number of combined sewer overflow points and an estimation, with basis, of what percentage of the total collection system is combined; and

6. Any other data that the Department deems appropriate to make an accurate determination on the merits of the request.

(g) When requesting special consideration for the discharge under (e) above, an applicant shall submit all applicable demonstrations specified in (e) 1 and 2, and, in addition, the following:

1. If the discharge is also regulated by another regulatory agency (for example, Delaware River Basin Commission, Interstate Environmental Commission,), a brief written statement from that regulatory agency that the agency has no objection to the request for special consideration;

2. The adjustment requested; and

3. Any other data that the Department deems appropriate to make an accurate determination on the merits of the request.

(h) The following domestic treatment works are not eligible to request special consideration under this section:

1. Any domestic treatment works which cannot provide satisfactory demonstrations as required pursuant to (b) through (e) above, as applicable; and

2. Any domestic treatment works subject to the requirements of another regulatory agency (for example, Delaware River Basin Commission, Interstate Environmental Commission) that has not received a written statement from that agency that it has no objection to the request.

7:14A-12.4 Minimum BOD_5 Effluent Standards

(a) For direct discharges to surface water for which (BOD5 or CBOD5) water quality based effluent limitations based upon water quality studies acceptable to the Department have not been developed but are required under N.J.A.C. 7:9B-1.5 or 1.6, the minimum treatment requirements for BOD5 specified in (b) below shall apply except when more stringent effluent limitations are required by:

1. Section 301 or 306 of the Federal Act;

2. The Delaware River Basin Commission or the Interstate Environmental Commission, as applicable.

(b) The minimum BOD_5 treatment requirements are as listed in the following table:

WATERSHED TYPE	RECEIVING WATER CLASSIFICATION	BOD_5 MAXIMUM (MONTHLY/WEEKLY AVG.)	DISCHARGE
Atlantic Coastal Plain	FW2, SE1 SC	15/22.5 mg/L 30/45 mg/l	All Domestic or Domestic combined with industrial
Delaware River Basin	Tributaries Classified as FW2, SE1, SE2 Main stem all zones	25/37.5 mg/L As set forth in the Water Quality Standards for the Delaware River Basin; Resolution 67-7 of the DRBC; April 26, 1967 and subsequent revisions	All All

Hackensack River Basin	FW2, SE1, SE2, SE3	30/45 mg/L	All
Passaic River Basin (including Newark Bay)	FW2 SE2, SE3	25/37.5 mg/L 30/45 mg/L	All All
Wallkill River Basin	FW2	15/22.5 mg/L	All

(c) In applying the minimum treatment requirements contained in (b) above, the following substitutions may be made:

1. For industrial treatment works, TOC or COD may be substituted for BOD5 when a long-term BOD5:COD or BOD5:TOC correlation has been demonstrated. In the absence of data (to establish a long term correlation), the BOD5:COD ratio shall be assumed to be 1:2 and the BOD5:TOC ratio shall be assumed to be 1:1. If subsequent data are submitted which indicate that a different BOD5:COD or BOD5:TOC ratio would be more appropriate, a written request shall be submitted to the Department; and

2. For industrial or domestic treatment works, $CBOD_5$ may be substituted for BOD_5 as follows:

i. With prior approval of each regulatory agency with jurisdiction over the discharge, when applicable, if the effluent standard for BOD5 is 30/45 mg/L, a CBOD5 effluent standard of 25/40 mg/L, as allowed for in N.J.A.C. 7:14A-12.2(c)1 and 2, may be substituted; or

ii. With prior approval of each regulatory agency with jurisdiction over the discharge, when applicable, if the effluent standard for BOD5 is other than 30/45 mg/L, CBOD5 may be substituted for BOD5 when a long term BOD5:CBOD5 correlation has been demonstrated. When a request for a substitution of CBOD5 for BOD5 is made, the applicant shall submit data demonstrating the appropriate BOD5:CBOD5 correlation. The correlation demonstration shall consist of a minimum of 12 BOD5 and CBOD5 analyses of split samples obtained at a frequency of twice per month, subject to the following restrictions:

(1) For limitations applicable year round, or for limitations applicable during warm weather (for example, May through October), the samples shall be obtained during the months of May through October.

(2) For limitations applicable during cold weather (for example, November through April), the samples shall be obtained during the months of November through April.

(3) The monthly and weekly BOD_5 effluent limitations shall be recalculated as $CBOD_5$ monthly and weekly effluent limitations using the approved correlation factor.

(d) Direct discharges to surface water from industrial treatment works shall be exempt from the minimum BOD_5 effluent standards in (b) above, when:

i. Statistically valid data indicate that the maximum projected BOD_5 concentration is consistently below the applicable effluent standard; or

ii. The Department determines that, based on wastewater generating activities, no potential exists for the discharge to add BOD_5, COD or TOC.

7:14A-12.5 Disinfection

(a) All wastewater that could contain pathogenic organisms such as fecal coliform and/or enterococci organisms shall be subject to continuous year round disinfection prior to discharge into surface waters.

(b) The State effluent standard for fecal coliform organisms is as follows:

1. The monthly geometric mean shall not exceed 200 colonies/100 mL; and

2. The weekly geometric mean shall not exceed 400 colonies/100 mL.

7:14A-12.6 Foam

(a) DSW dischargers are prohibited from discharging foam or causing foaming of the receiving water that:

1. Forms objectionable deposits on the receiving water;

2. Forms floating masses producing a nuisance;

3. Produces objectionable color or odor; or

4. Interferes with a designated use of the waterbody.

(b) Foaming of the receiving waterbody caused by natural conditions shall not be considered a violation of the standard in (a) above.

(c) For discharges with submerged outfalls, the Department may take into consideration the location, depth and the dispersion characteristics of the discharge in deciding whether or not to include the provisions of (a) above in the permit.

7:14A-12.7 Phosphorus effluent standard

The effluent standard for phosphorus discharged to a freshwater lake, pond or reservoir, or tributaries to these waterbodies is that, at a minimum, no effluent shall contain more than 1.0 mg/l total phosphorus (as P), as a monthly average, unless the discharger(s) to such a waterbody can demonstrate that a less stringent requirement will not result in a violation of the Surface Water Quality Standards (N.J.A.C. 7:9B) or that the control of point sources alone, in the absence of effective nonpoint source controls, will not result in a significant reduction of phosphorus loadings to the waterbody.

7:14A-12.8 Oil and grease effluent standards

(a) The requirements of N.J.A.C. 7:14A-12.8 through 12.10 apply to direct discharges of oil and grease to surface water, and indirect discharges of petroleum based oil and grease to a domestic treatment works, except as specifically exempted in N.J.A.C. 7:14A-12.10. Indirect users shall comply with any local agency standards for nonpetroleum based oil and grease.

(b) (Reserved.)

(c) Direct dischargers to surface waters shall limit the oil and grease effluent content so that such effluent does not:

1. Exhibit a visible sheen;

2. Exceed an average monthly discharge limitation of 10 mg/L; and

3. Exceed a concentration of 15 mg/L in any single sample.

(d) Indirect users discharging petroleum based oil and grease shall meet the following petroleum hydrocarbon effluent standards except where the control authority has determined that more stringent effluent limitations apply:

1. The average monthly discharge limitation shall not exceed 100 mg/L; and

2. The concentration in any single sample shall not exceed 150 mg/L.

(e) (Reserved.)

(f) If a direct discharger only discharges petroleum based oil and grease, the Department may specify in the permit that compliance with the oil and grease effluent standards in 12.8(c) above may be monitored using the petroleum hydrocarbons analytical method.

7:14A-12.9 (Reserved.)

7:14A-12.10 Petroleum Hydrocarbon Exemptions

(a) Indirect users shall be exempted from the petroleum hydrocarbon standards specified at N.J.A.C. 7:14A-12.8(d), provided the following requirements are met:

1. The DTW into which the indirect user discharges submits a request for the exemption indicating it meets all of the following criteria:

i. The discharge from the domestic treatment works has met a 10 mg/L average and 15 mg/L maximum limitation for oil and grease for each of the reporting periods during the preceding 12 months, as determined by the Department;

ii. The sludge disposal option currently utilized or planned by the domestic treatment works considers petroleum hydrocarbons a beneficial constituent; and

iii. The DTW shows that the costs for oil and grease removal at its plant are in proportion to the other operation and maintenance costs of the plant.

2. The Department shall have 90 days to review the request for the exemption and make a tentative decision to approve or deny the request. If additional information from the applicant is required, the 90 day period may be extended. The Department shall public notice the tentative decision.

7:14A-12.11 Toxic Effluent Standards

(a) (Reserved.)

(b) (Reserved.)

(c) (Reserved.)

(d) For discharges to surface water from site remediation projects, the chemical specific toxic pollutant effluent standards are set forth in N.J.A.C. 7:14A-12 Appendix B.

(e) For new sources, new discharges or expanded direct discharges to surface water, the chemical specific toxic pollutant effluent standards are set forth in N.J.A.C. 7:14A-12 Appendix C.

7:14A-12 Appendix A (Reserved.)

7:14A-12: Appendix B Effluent Standards for Site Remediation Projects

PARAMETER	EFFLUENT STANDARDS			
	FW-2 WATERS		SC, SE WATERS	
	monthly average	daily maximum	monthly average	daily maximum
VOLATILE COMPOUNDS				
Acrolein		100		100
Acrylonitrile		50		50
Benzene		7	37	136
Bromoform		8.6	29	58

Carbon Tetrachloride		6		8.8
Chlorobenzene	15	28	15	28
Chlorodibromomethane		8.2		14
Chloroethane	104	268	104	268
Chloroform		11.4	21	46
Dichlorobromomethane		5		12
1,1-Dichloroethane	22	59	22	59
1,2-Dichloroethane		3	68	211
1,1-Dichloroethylene		6	16	25
1,2-Dichloropropane	153	230	153	230
1,3-Dichloropropylene	10	20	29	44
Ethylbenzene	32	108	32	108
Methyl Bromide	20	40	20	40
Methyl Chloride	86	190	86	190
Methylene Chloride		9.4	40	89
1,1,2,2-Tetrachloroethane		10		10
Tetrachloroethylene		16	22	56
Toluene	26	80	26	80
1,2-Trans-Dichloroethylene	21	54	21	54
1,1,1-Trichloroethane	21	54	21	54
1,1,2-Trichloroethane		12	21	54
Trichloroethylene		5.4	21	54
Vinyl Chloride		10	104	268
ACID COMPOUNDS				
2-Chlorophenol	31	98	31	98
2,4-Dichlorophenol	39	112	39	112
2,4-Dimethylphenol	18	36	18	36
4,6-Dinitro-O-Cresol		60	78	277
2,4-Dinitrophenol	71	123	71	123
2-Nitrophenol	41	69	41	69
4-Nitrophenol	72	124	72	124
Pentachlorophenol		30		30
Phenol	15	26	15	26
2,4,6-Trichlorophenol		20		20

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum
2 - for manufacturers and formulators - discharge prohibited
3 - for manufacturers: 1.5 ug/L daily maximum, 7.5 ug/L instantaneous maximum
for formulators: discharge prohibited

PARAMETER	EFFLUENT STANDARDS			
	FW-2 WATERS		SC, SE WATERS	
	monthly average	daily maximum	monthly average	daily maximum
BASE NEUTRAL COMPOUNDS				
Anthracene	22	59	22	59
Benzidine		50		50
Benzo (a) Anthracene		10		10
Benzo (a) Pyrene		20		20
Benzo(b)fluoranthene		10		10
Benzo (k) Fluoranthene		20		20
Bis (2-Chloroethyl) Ether		10		10
Bis (2-Chloroisopropyl) Ether	301	757	301	757
Bis (2-Ethylhexyl) Phthalate		36	59	118
Butyl Benzyl Phthalate		24		24
Chrysene		20		20
Dibenzo (a,h) Anthracene		20		20
1,2-Dichlorobenzene	77	163	77	163
1,3-Dichlorobenzene	31	44	31	44
1,4-Dichlorobenzene		28		28
3,3'-Dichlorobenzidine		60		60
Diethyl Phthalate	81	203	81	203
Dimethyl Phthalate	19	47	19	47
Di-N-Butyl Phthalate	27	57	27	57
2,4 Dinitrotoluene		10		18.2
2,6-Dinitrotoluene	255	641	255	641
Fluoranthene	25	68	25	68
Fluorene	22	59	22	59
Hexachlorobenzene		10		10
Hexachlorobutadiene		10	20	49
Hexachlorocyclopentadiene	240	480		1800
Hexachloroethane	19	38	21	54
Indeno (1,2,3-cd) Pyrene		20		20
Isophorone		20		20
Naphthalene	22	59	22	59
Nitrobenzene	17	34	27	68

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 1.5 ug/L daily maximum, 7.5 ug/L instantaneous maximum
for formulators: discharge prohibited

N-Nitrosodimethylamine		20		20
N-Nitrosodiphenylamine		20		20
Phenanthrene	22	59	22	59
Pyrene	25	67	25	67
1,2,4-Trichlorobenzene	68	140	68	140

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 1.5 ug/L daily maximum, 7.5 ug/L instantaneous maximum
for formulators: discharge prohibited

PARAMETER	EFFLUENT STANDARDS			
	FW-2 WATERS		SC, SE WATERS	
	monthly average	daily maximum	monthly average	daily maximum
PESTICIDES				
Aldrin [2]		0.04		0.04
Alpha-BHC		0.02		0.02
Beta-BHC	0.137	0.274	0.46	0.92
Gamma-BHC (Lindane)		0.08		0.03
Chlordane		0.2		0.2
4,4'-DDT [2]		0.06		0.06
4,4'-DDE [2]		0.04		0.04
4,4'-DDD [2]		0.04		0.04
Dieldrin [2]		0.03		0.03
Alpha-Endosulfan		0.02		0.02
Beta-Endosulfan		0.04		0.04
Endosulfan Sulfate	0.93	1.86	2	4
Endrin [3]		0.04		0.04
Endrin Aldehyde	0.76	1.52	0.81	1.62
Heptachlor		0.02		0.02
Heptachlor Epoxide		0.4		0.4
Toxaphene [3]		1		1
METALS AND CYANIDE				
Arsenic	50	100	50	100
Cadmium	50	100	50	100
Chromium	50	100	50	100
Copper	50	100	50	100
Iron	1000	2000	1000	2000
Lead	50	100	50	100
Mercury		1		1
Nickel	72	144	50	100
Selenium	50	100	50	100
Silver	25	50	25	50
Zinc	100	200	100	200
Cyanide	100	200	100	200
DIOXIN				

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 1.5 ug/L daily maximum, 7.5 ug/L instantaneous maximum
for formulators: discharge prohibited

2,3,7,8-Tetrachlorodibenzo -p-Dioxin		0.01		0.01
PCBs [2]				
PCBs-1242, 1254, 1221, 1232, 1248, 1260, 1016		0.5		0.5

i

i

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 1.5 ug/L daily maximum, 7.5 ug/L instantaneous maximum
for formulators: discharge prohibited

This is a courtesy copy of this rule. All of the Department's rules are compiled in Title 7 of the New Jersey Administrative Code.

7:14A-12: Appendix C **Effluent Standards for New Sources, New Discharges or Expanded Direct Discharges**

PARAMETER	FACILITY FLOW < 7Q 10 & LARGE TIDAL				FACILITY FLOW > 7Q 10 & SMALL TIDAL			
	FW2 WATERS		SE, SC WATERS		FW2 WATERS		SE, SC WATERS	
	monthly average	daily maximum	monthly average	daily maximum	monthly average	daily maximum	monthly average	daily maximum
VOLATILE COMPOUNDS								
Acrolein		100		100		100		100
Acrylonitrile		50		50		50		50
Benzene		24	37	136		7	37	136
Bromoform	29	58	29	58		8.6	29	58
Carbon Tetrachloride		6	18	38		6		8.8
Chlorobenzene	15	28	15	28	15	28	15	28
Chlorodibromomethane		14		14		8.2		14
Chloroethane	104	268	104	268	104	268	104	268
Chloroform	21	46	21	46		11.4	21	46
Dichlorobromomethane		5.4		12		5		12
1,1-Dichloroethane	22	59	22	59	22	59	22	59
1,2-Dichloroethane		7.6	68	211		3	68	211
1,1-Dichloroethylene	16	11.4	16	25		6	16	25
1,2-Dichloropropane	153	230	153	230	153	230	153	230
1,3-Dichloropropylene	29	44	29	44		20	29	44
Ethylbenzene	32	108	32	108	32	108	32	108
Methyl Bromide	20	40	20	40	20	40	20	40
Methyl Chloride	86	190	86	190	86	190	86	190
Methylene Chloride	40	89	40	89		9.4	40	89
1,1,2,2-Tetrachloroethane		10		10		10		10
Tetrachloroethylene	22	56	22	56		16	22	56
Toluene	26	80	26	80	26	80	26	80
1,2-Trans-Dichloroethylene	21	54	21	54	21	54	21	54
1,1,1-Trichloroethane	21	54	21	54	21	54	21	54
1,1,2-Trichloroethane	21	54	21	54		12	21	54
Trichloroethylene	21	54	21	54		5.4	21	54
Vinyl Chloride	20	40	104	268		10	104	268
ACID COMPOUNDS								
2-Chlorophenol	31	98	31	98	31	98	31	98

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

2,4-Dichlorophenol	39	112	39	112	39	112	39	112
2,4-Dimethylphenol	18	36	18	36	18	36	18	36
4,6-Dinitro-O-Cresol	78	277	78	277		60	78	277
2,4-Dinitrophenol	71	123	71	123	71	123	71	123
2-Nitrophenol	41	69	41	69	41	69	41	69
4-Nitrophenol	72	124	72	124	72	124	72	124
Pentachlorophenol		30		30		30		30
Phenol	15	26	15	26	15	26	15	26
2,4,6-Trichlorophenol		42	65	130		20		20

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

PARAMETER	FACILITY FLOW < 7Q 10 & LARGE TIDAL				FACILITY FLOW > 7Q 10 & SMALL TIDAL			
	FW2 WATERS		SE, SC WATERS		FW2 WATERS		SE, SC WATERS	
	monthly average	daily maximum	monthly average	daily maximum	monthly average	daily maximum	monthly average	daily maximum
BASE NEUTRAL COMPOUNDS								
Anthracene	22	59	22	59	22	59	22	59
Benzidine [1]		50		50		50		50
Benzo (a) Anthracene		10		10		10		10
Benzo (a) Pyrene		20		20		20		20
Benzo(b)fluoranthene		10		10		10		10
Benzo (k) Fluoranthene		20		20		20		20
Bis (2-Chloroethyl) Ether		10	14	28		10		10
Bis (2-Chloroisopropyl) Ether	301	757	301	757	301	757	301	757
Bis (2-Ethylhexyl) Phthalate	103	279	103	279		36	59	118
Butyl Benzyl Phthalate		24		24		24		24
Chrysene		20		20		20		20
Dibenzo (a,h) Anthracene		20		20		20		20
1,2-Dichlorobenzene	77	163	77	163	77	163	77	163
1,3-Dichlorobenzene	31	44	31	44	31	44	31	44
1,4-Dichlorobenzene		28		28		28		28
3,3'-Dichlorobenzidine		60		60		60		60
Diethyl Phthalate	81	203	81	203	81	203	81	203
Dimethyl Phthalate	19	47	19	47	19	47	19	47
Di-N-Butyl Phthalate	27	57	27	57	27	57	27	57
2,4 Dinitrotoluene		10	91	182		10		18.2
2,6-Dinitrotoluene	255	641	255	641	255	641	255	641
1,2-Diphenylhydrazine	0.4	0.8	5.4	10.8	0.04	0.08	0.54	1.08
(as Azobenzene)								
Fluoranthene	25	68	25	68	25	68	25	68
Fluorene	22	59	22	59	22	59	22	59
Hexachlorobenzene		10		10		10		10
Hexachlorobutadiene	20	49	20	49		10	20	49
Hexachlorocyclopentadiene		1800		1800	240	480		1800
Hexachloroethane	21	54	21	54	19	38	21	54
Indeno (1,2,3-cd) Pyrene		20		20		20		20

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

Isophorone		20		20		20		20
Naphthalene	22	59	22	59	22	59	22	59
Nitrobenzene	27	68	27	68	17	34	27	68
N-Nitrosodimethylamine		20	73	146		20		20
N-Nitrosodiphenylamine		20		20		20		20
Phenanthrene	22	59	22	59	22	59	22	59
Pyrene	25	67	25	67	25	67	25	67
1,2,4-Trichlorobenzene	68	140	68	140	68	140	68	140

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

This is a courtesy copy of this rule. All of the Department's rules are compiled in Title 7 of the New Jersey Administrative Code.

PARAMETER	FACILITY FLOW < 7Q 10 & LARGE TIDAL				FACILITY FLOW > 7Q 10 & SMALL TIDAL			
	FW2 WATERS		SE, SC WATERS		FW2 WATERS		SE, SC WATERS	
	monthly average	daily maximum	monthly averageg	daily maximum	monthly average	daily maximum	monthly average	daily maximum
PESTICIDES								
Aldrin [2]		0.04		0.04		0.04		0.04
Alpha-BHC	0.0391	0.0782	0.131	0.262		0.02		0.026
Beta-BHC	1.4	2.8	4.6	9.2		0.28	0.46	0.92
Gamma-BHC (Lindane)		0.38		0.32		0.037		0.125
Chlordane		0.2		0.2		0.2		0.2
4,4'-DDT [2]		0.06		0.06		0.06		0.06
4,4'-DDE [2]		0.04		0.04		0.04		0.04
4,4'-DDD [2]		0.04		0.04		0.04		0.04
Dieldrin [2]		0.03		0.03		0.03		0.03
Alpha-Endosulfan	0.22	0.44		0.068		0.092		0.02
Beta-Endosulfan	0.22	0.44		0.068		0.092		0.02
Endosulfan Sulfate	9.3	18.6	20	40	0.93	1.86	2	4
Endrin [3]		0.04		0.04		0.04		0.04
Endrin Aldehyde	7.6	15.2	8.1	16.2		1.52		1.62
Heptachlor		0.02		0.02		0.02		0.02
Heptachlor Epoxide		0.4		0.4		0.4		0.4
Toxaphene [3]		1		1		1		1
METALS								
Antimony	140	280				28		
Arsenic		8		8		8		8
Cadmium		4	43	86		4		15.2
Chromium, hexavalent	50	100	50	100	50	100	50	100
Chromium, total		32	409	818		16	41	82
Copper		18.4		10		10		10
Iron	1500	3000	1500	3000	1000	2000	1500	3000
Lead		21	69.5	139		10		13.9
Mercury		1		1		1		1
Nickel	720	1440	67.9	136	72	144		13.6
Selenium	20	40	300	600		10		
Silver		2.4		4.6		2		2
Thallium	17	34	62.2	124.4		10		12.4

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

Zinc	65	130	95	190		65	47.5	95
Cyanide		44		40		40		40
Total PCB's [2]		0.5		0.5		0.5		0.5
DIOXIN								
2,3,7,8-Tetrachlorodibenzo -p-Dioxin		0.01		0.01		0.01		0.01
WHOLE EFFLUENT								
Chronic IC_{25} (% effluent)		>=50		>=50		>=100		>=100

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum
2 - for manufacturers and formulators - discharge prohibited
3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

all units in ug/L

1 -for maunfacturers: 10 ug/L daily maximum and 50 ug/L instantaneous maximum
for applicators: 10 ug/L daily maximum and 25 ug/L instantaneous maximum

2 - for manufacturers and formulators - discharge prohibited

3 - for manufacturers: 0.1 ug/L daily maximum, 0.5 ug/L instantaneous maximum
for formulators: discharge prohibited

Appendix G:
Middlesex County Utilities Authority –
Temporary Discharge Approval Application

MIDDLESEX COUNTY UTILITIES AUTHORITY
P.O. Box 159, Sayreville, NJ 08872-0159
(732)721-3800 Fax(732)727-2254

TEMPORARY DISCHARGE APPROVAL APPLICATION

Groundwater Remediation Control

____ New ____ Renew ____ Modify TDA No. ________

SECTION 1. APPLICANT/RESPONSIBLE PARTY:

1.1. Company name, mailing address, and telephone number.
____
____
____
Telephone No. ______________________________

1.2. Site Identification

I. Site name:____
II. Street:____
III. City:____
IV. State/Zip Code/County:____
V. Owner/Operator:____
VI. Telephone no.:____
VII. Type of Ownership: ____ Federal ____ State ____ County
____ Municipal ____ Private ____ Unknown
VIII. Site Description:____

1.3 Person to contact concerning information herein:
Name/Title: ____
Company:____
Telephone:_ ____

1.4 Authorized representative for the applicant/responsible party:
Name/Title____
Company :____
Telephone:____

1.5 Operational status of any facilities at the site:

Open ____ Closed ____ Under Construction ____ Proposed ____

Date began/ended/proposed to begin ______________________________

1.6 Please indicate if the facility employs (past, present) a process in any of the following industrial categories or business activities listed below:

___ Aluminum Forming
___ Asbestos Manufacturing
___ Battery Manufacturing
___ Builder's Paper Board and Mills
___ Carbon Black Manufacturing
___ Cement Manufacturing
___ Coil Coating
___ Copper Forming
___ Dairy Products Processing
___ Electrical & Electronic Components
___ Electroplating/Metal Finishing
___ Explosives Manufacturing
___ Feedlots
___ Ferroalloy Manufacturing
___ Fertilizer Manufacturing
___ Food/Edible Products- Specify:____________________________
___ Glass Manufacturing
___ Grain Mills Manufacturing
___ Gum & Wood Chemicals
___ Hospitals
___ Industrial Laundries
___ Ink Formulating
___ Inorganic Chemicals
___ Iron &Steel
___ Leather Tanning & Finishing
___ Meat Processing
___ Metal Products & Machinery
___ Metal Molding & Casting (Foundries)
___ Mining and Processing
___ Nonferrous Metals Forming and Metal Powders
___ Nonferrous Metals Manufacturing
___ Oil and Gas Extraction/Coastal Oil & Gas
___ Organic Chemicals, Plastics and Synthetic Fibers
___ Paint Formulating
___ Paving and Roofing Materials)tars and Asphalts)
___ Pesticide Chemicals/Formulating & Packaging
___ Petroleum Refining
___ Pharmaceutical Manufacturing
___ Phosphate Manufacturing

___ Photographic Processing
___ Plastics Molding and Forming
___ Porcelain Enameling
___ Pulp, Paper, and Paperboard
___ Rubber Manufacturing
___ Soap & Detergent Manufacturing
___ Steam Electric Power Generating
___ Textile Mills
___ Timber Products Processing
___ Transportation Equipment Cleaning
___ Waste Treatment
___ Other – explain:____

SECTION 2. DISCHARGE INFORMATION

2.1 Description of project and need for Temporary Discharge Approval. (Attach additional sheets if necessary)

____
____
____
____

2.2 NJDEP Case Number

Name:____

Division:____

Bureau:____

Address:____

Telephone:____

2.3 Duration of proposed discharge

_____ Days _____ Weeks _____ Months _____ Years

A Temporary Discharge Approval shall have a term of one year, renewable each year upon application to and the approval of the Authority, subject to a maximum life of 5 years. After a Temporary Discharge Approval reaches its maximum life of 5 years, it shall expire and the discharge shall cease, unless the Authority, in its discretion, determines to issue a new Temporary Discharge Approvals.

2.4 Volume of propose discharge

_____ Gallons per minute

_____ Gallons per day

_____ Total gallons for duration of project maximum of one year.

2.5 Pretreatment of proposed discharge

___ Air Flotation
___ Biological Treatment, type____________________________
___ Centrifuge
___ Chemical Precipitation
___ Chlorination
___ Cyclone
___ Filtration
___ Flow Equalization
___ Grease Trap
___ Grit Removal
___ Ion Exchange
___ Neutralization, pH Correction
___ Oil or Grease Separation, type______________________________
___ Ozonation
___ Rainwater Diversion or Storage_____________________________
___ Reverse Osmosis
___ Screen
___ Sedimentation
___ Septic Tank
___ Solvent Separation
___ Spill Prevention
___ Sump
___ Other, explain____
___ No Pretreatment Provided

SECTION 3. PROPOSED DISCHARGE CONSTITUENT CONCENTRATIONS

Please indicate by placing an “x” in the appropriate box by each listed chemical whether it is “Believed Absent”, or “Believed Present” in the proposed discharge. If the effluent concentration is known or can be estimated, please fill in the appropriate space next to the chemical. If any analyses have been performed on the proposed discharge attach a copy of the most recent data to this application. Be sure to include the date of the analysis, name of the laboratory performing the analysis, location(s) from which sample(s) were taken (attach sketches, plans, etc., as necessary), type of sample taken (e.g. composite, grab), and chain of custody form. Please indicate which concentration measurements are estimated with an E, and explain estimation process.

3.1A USEPA PRIORITY POLLUTANT

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Acenaphthene	[ ]	[ ]	[ ]
Acrolein	[ ]	[ ]	[ ]
Acrylonitrile	[ ]	[ ]	[ ]
Benzene	[ ]	[ ]	[ ]
Benzidine	[ ]	[ ]	[ ]
Carbon tetrachloride	[ ]	[ ]	[ ]
Chlorobenzene	[ ]	[ ]	[ ]
1,2,4-Trichlorobenzene	[ ]	[ ]	[ ]
Hexachlorobenzene	[ ]	[ ]	[ ]
1,2-Dichloroethane	[ ]	[ ]	[ ]
1,1,1-Trichloroethane	[ ]	[ ]	[ ]
Hexachlorobenzene	[ ]	[ ]	[ ]
1,1,2-Trichloroethane	[ ]	[ ]	[ ]
1,1,2,2-Tetrachloroethane	[ ]	[ ]	[ ]
Chloroethane	[ ]	[ ]	[ ]
Bis(chloromethyl)ether	[ ]	[ ]	[ ]
Bis(2-chloroethyl)ether	[ ]	[ ]	[ ]
2-Chloroethyl vinyl ether	[ ]	[ ]	[ ]
2-Chloronaphthalene	[ ]	[ ]	[ ]
2,4,6-Trichlorophenol	[ ]	[ ]	[ ]
p-Chloro-m-cresol	[ ]	[ ]	[ ]
Chloroform	[ ]	[ ]	[ ]
2-Chlorophenol	[ ]	[ ]	[ ]
1,2-Dichlorobenzene	[ ]	[ ]	[ ]
1,3-Dichlorobenzene	[ ]	[ ]	[ ]
1,4-Dichlorobenzene	[ ]	[ ]	[ ]
3,3-Dichlorobenzidine	[ ]	[ ]	[ ]
1,1-Dichloroethylene	[ ]	[ ]	[ ]
1,2-Trans-Dichloroethylene	[ ]	[ ]	[ ]
2,4-Dichlorophenol	[ ]	[ ]	[ ]
1,2-Dichloropropane	[ ]	[ ]	[ ]
1,3-Dichloropropylene	[ ]	[ ]	[ ]
(1,3-dichloropropene)	[ ]	[ ]	[ ]
2,4-Dimethylphenol	[ ]	[ ]	[ ]
2,4-Dinitrotoluene	[ ]	[ ]	[ ]
2,6-Dinitrotoluene	[ ]	[ ]	[ ]
1,2-Diphenylhydrazine	[ ]	[ ]	[ ]
Ethylbenzene	[ ]	[ ]	[ ]
Fluoranthene	[ ]	[ ]	[ ]
4-Chorophenyl phenyl ether	[ ]	[ ]	[ ]

3.1A USEPA PRIORITY POLLUTANT Continued

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
4-Bromophenyl phenyl ether	[ ]	[ ]	[ ]
Bis(2-chloroisopropyl)ether	[ ]	[ ]	[ ]
Bis(2-chloroethoxy)methane	[ ]	[ ]	[ ]
Methylene chloride	[ ]	[ ]	[ ]
Methyl chloride (Chloromethane)	[ ]	[ ]	[ ]
Methyl bromide (Bromomethane)	[ ]	[ ]	[ ]
Bromoform	[ ]	[ ]	[ ]
Dichlorobromomethane	[ ]	[ ]	[ ]
Chlorodibromoethane	[ ]	[ ]	[ ]
Hexachlorobutadiene	[ ]	[ ]	[ ]
Hexachlorocyclopentadiene	[ ]	[ ]	[ ]
Isohprone	[ ]	[ ]	[ ]
Naphthalene	[ ]	[ ]	[ ]
Nitrobenzene	[ ]	[ ]	[ ]
2-Nitrophenol	[ ]	[ ]	[ ]
4-Nitrophenol	[ ]	[ ]	[ ]
4,6-Dinitro-o-cresol	[ ]	[ ]	[ ]
N-nitrosodimethylamine	[ ]	[ ]	[ ]
N-nitrosodiphenylamine	[ ]	[ ]	[ ]
N-nitrosodi-n-propylamine	[ ]	[ ]	[ ]
Pentachlorophenol	[ ]	[ ]	[ ]
Phenol	[ ]	[ ]	[ ]
Bis(2-ethylhexyl)phthalate	[ ]	[ ]	[ ]
Butyl benzyl phthalate	[ ]	[ ]	[ ]
Di-n-butyl phthalate	[ ]	[ ]	[ ]
Di-n-octyl phthalate	[ ]	[ ]	[ ]
Diethyl phthalate	[ ]	[ ]	[ ]
Dimethyl phthalate	[ ]	[ ]	[ ]
Benzo(a)anthracene	[ ]	[ ]	[ ]
Benzo(a)pyrene	[ ]	[ ]	[ ]
3,4,-Benzofluoranthene	[ ]	[ ]	[ ]
Benzo(k)fluoranthene	[ ]	[ ]	[ ]
Chrysene	[ ]	[ ]	[ ]
Acenaphthylene	[ ]	[ ]	[ ]
Anthracene	[ ]	[ ]	[ ]
Benzo(ghi)perylene	[ ]	[ ]	[ ]
Fluorene	[ ]	[ ]	[ ]
Phenanthrene	[ ]	[ ]	[ ]
Dibenzo(a,h)anthracene	[ ]	[ ]	[ ]

3.4A USEPA PRIORITY POLLUTANT Continued

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Indeno(1,2,3-cd)pyrene	[ ]	[ ]	[ ]
Pyrene	[ ]	[ ]	[ ]
Tetrachloroethylene (Perchlor)	[ ]	[ ]	[ ]
Tolune	[ ]	[ ]	[ ]
Trichloroethylene (Trichloroethene)	[ ]	[ ]	[ ]
Vinyl chloride	[ ]	[ ]	[ ]
Aldrin	[ ]	[ ]	[ ]
alpha-BHC	[ ]	[ ]	[ ]
beta-BHC	[ ]	[ ]	[ ]
gamma-BHC (Lindane)	[ ]	[ ]	[ ]
delta-BHC	[ ]	[ ]	[ ]
4,4-DDT	[ ]	[ ]	[ ]
4,4-DDE	[ ]	[ ]	[ ]
4,4-DDD	[ ]	[ ]	[ ]
Chlordane	[ ]	[ ]	[ ]
Dieldrin	[ ]	[ ]	[ ]
Endosulfan I	[ ]	[ ]	[ ]
Endosulfan II	[ ]	[ ]	[ ]
Endosulfan sulfate	[ ]	[ ]	[ ]
Endrin	[ ]	[ ]	[ ]
Endrin aldehyde	[ ]	[ ]	[ ]
Heptachlor epoxide	[ ]	[ ]	[ ]
Toxaphene	[ ]	[ ]	[ ]
PCB-1016	[ ]	[ ]	[ ]
PCB-1221	[ ]	[ ]	[ ]
PCB-1232	[ ]	[ ]	[ ]
PCB-1242	[ ]	[ ]	[ ]
PCB-1248	[ ]	[ ]	[ ]
PCB-1254	[ ]	[ ]	[ ]
PCB-1260	[ ]	[ ]	[ ]
Antimony(total)	[ ]	[ ]	[ ]
Arsenic(total)	[ ]	[ ]	[ ]
Beryllium(total)	[ ]	[ ]	[ ]
Cadmium(total)	[ ]	[ ]	[ ]
Chromium(total)	[ ]	[ ]	[ ]
Copper(total)	[ ]	[ ]	[ ]
Cyanide(total)	[ ]	[ ]	[ ]
Lead(total)	[ ]	[ ]	[ ]
Mercury(total)	[ ]	[ ]	[ ]

3.4A USEPA PRIORITY POLLUTANT Continued

Chemical Compound	Believed Absent	Known or Believed Present	Suspected Conc. (mg/L)
Nickel(total)	[ ]	[ ]	[ ]
Selenium(total)	[ ]	[ ]	[ ]
Silver(total)	[ ]	[ ]	[ ]
Thallium(total)	[ ]	[ ]	[ ]
Zinc(total)	[ ]	[ ]	[ ]
2,3,7,8-tetrachloro-dibenzo-p-dioxin	[ ]	[ ]	[ ]

3.4B NJDEPE EXPANDED PRIORITY POLLUTANTS Continued

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Acrylamide	[ ]	[ ]	[ ]
Amitrole	[ ]	[ ]	[ ]
Amyl alcohols	[ ]	[ ]	[ ]
Aniline hydrochloride	[ ]	[ ]	[ ]
Anisole	[ ]	[ ]	[ ]
Auramine	[ ]	[ ]	[ ]
Benzotrichloride	[ ]	[ ]	[ ]
Benzylamine	[ ]	[ ]	[ ]
o-Chloroaniline	[ ]	[ ]	[ ]
m-Chloroaniline	[ ]	[ ]	[ ]
p-Chloroaniline	[ ]	[ ]	[ ]
1-Chloro-2-nitrobenzene	[ ]	[ ]	[ ]
1-Chloro-4-nitrobenzene	[ ]	[ ]	[ ]
Chloroprene	[ ]	[ ]	[ ]
Chrysoidine	[ ]	[ ]	[ ]
Cumene	[ ]	[ ]	[ ]
2,3-Dichloroaniline	[ ]	[ ]	[ ]
2,4- Dichloroaniline	[ ]	[ ]	[ ]
2,5- Dichloroaniline	[ ]	[ ]	[ ]
3,4- Dichloroaniline	[ ]	[ ]	[ ]
3,5-Dichloroaniline	[ ]	[ ]	[ ]
1,3-Dichloropropene	[ ]	[ ]	[ ]
1,3’-Dimethoxybenzidine	[ ]	[ ]	[ ]
n,n-Dimethyl aniline	[ ]	[ ]	[ ]
3,3’-Dimethyl benzidine	[ ]	[ ]	[ ]
1,1-Dimethylhydrazine	[ ]	[ ]	[ ]
Dioxane	[ ]	[ ]	[ ]
Diphenylamine	[ ]	[ ]	[ ]
Ethylenimine	[ ]	[ ]	[ ]
Hydrazine	[ ]	[ ]	[ ]
4,4’-Methyene bis (2-Chloroaniline)	[ ]	[ ]	[ ]
4,4’-Methylenedianiline	[ ]	[ ]	[ ]
Methyl isobutyl ketone	[ ]	[ ]	[ ]
alpha-Naphthylamine	[ ]	[ ]	[ ]
beta-Naphthylamine	[ ]	[ ]	[ ]
n-Methylaniline	[ ]	[ ]	[ ]
1,2-Phenylenediamine	[ ]	[ ]	[ ]
1,3-Phenylenediamine	[ ]	[ ]	[ ]
1,4-Phenylenediamine	[ ]	[ ]	[ ]

3.4B NJDEPE EXPANDED PRIORITY POLLUTANTS Continued

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Sudan I (Solvent yellow 14)	[ ]	[ ]	[ ]
Thiourea	[ ]	[ ]	[ ]
Toluene sulfonic acids	[ ]	[ ]	[ ]
Toluidines	[ ]	[ ]	[ ]
Xylidines	[ ]	[ ]	[ ]

3.4C USEPA HAZARDOUS SUBSTANCES

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Acetaldehyde	[ ]	[ ]	[ ]
Allyl alcohol	[ ]	[ ]	[ ]
Allyl chloride	[ ]	[ ]	[ ]
Amyl acetate	[ ]	[ ]	[ ]
Aniline	[ ]	[ ]	[ ]
Benzonitrile	[ ]	[ ]	[ ]
Benzyl chloride	[ ]	[ ]	[ ]
Butyl acetate	[ ]	[ ]	[ ]
Butylamine	[ ]	[ ]	[ ]
Captan	[ ]	[ ]	[ ]
Carbaryl	[ ]	[ ]	[ ]
Carbofuran	[ ]	[ ]	[ ]
Carbon disulfide	[ ]	[ ]	[ ]
Chloropyrifos	[ ]	[ ]	[ ]
Coumaphos	[ ]	[ ]	[ ]
Cresol	[ ]	[ ]	[ ]
Crotonaldehyde	[ ]	[ ]	[ ]
Cyclohexane	[ ]	[ ]	[ ]
2,4-D (2,4-dichlorophenoxy acetic acid)	[ ]	[ ]	[ ]
Diazinon	[ ]	[ ]	[ ]
Dicamba	[ ]	[ ]	[ ]
Dichlobenil	[ ]	[ ]	[ ]
Dichlone	[ ]	[ ]	[ ]
2,2-Dichloropropionic acid	[ ]	[ ]	[ ]
Dichlorvos	[ ]	[ ]	[ ]
Diethyl amine	[ ]	[ ]	[ ]
Dimethyl amine	[ ]	[ ]	[ ]
Dinitrobenzene	[ ]	[ ]	[ ]
Diguat	[ ]	[ ]	[ ]
Disulfoton	[ ]	[ ]	[ ]
Diuron	[ ]	[ ]	[ ]
Epichlorohydrin	[ ]	[ ]	[ ]
Ethanolaminie	[ ]	[ ]	[ ]
Ethion	[ ]	[ ]	[ ]
Ethylene diamine	[ ]	[ ]	[ ]
Ethylene dibromide	[ ]	[ ]	[ ]
Formaldehyde	[ ]	[ ]	[ ]
Furfural	[ ]	[ ]	[ ]
Guthion	[ ]	[ ]	[ ]
Isoprene	[ ]	[ ]	[ ]

3.4C USEPA HAZARDOUS SUBSTANCES Continued

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Isopropanolamine	[ ]	[ ]	[ ]
Kelthane	[ ]	[ ]	[ ]
Kepone	[ ]	[ ]	[ ]
Malathion	[ ]	[ ]	[ ]
Mercaptodimethur	[ ]	[ ]	[ ]
Methoxychlor	[ ]	[ ]	[ ]
Methyl mercaptan	[ ]	[ ]	[ ]
Methyl methacrylate	[ ]	[ ]	[ ]
Methyl parathion	[ ]	[ ]	[ ]
Mevinphos	[ ]	[ ]	[ ]
Mexacarbate	[ ]	[ ]	[ ]
Monoethyl aminie	[ ]	[ ]	[ ]
Monomethyl amine	[ ]	[ ]	[ ]
Naled	[ ]	[ ]	[ ]
Napthenic acid	[ ]	[ ]	[ ]
Nitrotoulene	[ ]	[ ]	[ ]
Parathion	[ ]	[ ]	[ ]
Phenosulfanate	[ ]	[ ]	[ ]
Phosgene	[ ]	[ ]	[ ]
Propargite	[ ]	[ ]	[ ]
Propylene oxide	[ ]	[ ]	[ ]
Pyrethrins	[ ]	[ ]	[ ]
Quinoline	[ ]	[ ]	[ ]
Resorcinol	[ ]	[ ]	[ ]
Strontium	[ ]	[ ]	[ ]
Strychnine	[ ]	[ ]	[ ]
Styrene	[ ]	[ ]	[ ]
2,4,5-T (2,4,5-Trichloro-phenoxy acetic acid)	[ ]	[ ]	[ ]
TDE (Tetrachloro-diphenylethane)	[ ]	[ ]	[ ]
2,4,5-TP [2-(2,4,5-Trichloro-phenoxy) propanoic acid]	[ ]	[ ]	[ ]
Trichlorofon	[ ]	[ ]	[ ]
Triethylamine	[ ]	[ ]	[ ]
Trimethylamine	[ ]	[ ]	[ ]
Uranium	[ ]	[ ]	[ ]
Vanadium	[ ]	[ ]	[ ]
Vinyl acetate	[ ]	[ ]	[ ]
Xylene	[ ]	[ ]	[ ]
Xylenol	[ ]	[ ]	[ ]
Zirconium	[ ]	[ ]	[ ]

3.4D MCUA PARAMETERS

Chemical Compound	Believed Absent	Believed Present	Known or Suspected Conc. (mg/L)
Ammonia	[ ]	[ ]	[ ]
Aluminum, Total	[ ]	[ ]	[ ]
Barium, Total	[ ]	[ ]	[ ]
Biological Oxygen Demand	[ ]	[ ]	[ ]
Boron, Total	[ ]	[ ]	[ ]
Bromide	[ ]	[ ]	[ ]
Chemical Oxygen Demand	[ ]	[ ]	[ ]
Chlorine, Total Residual	[ ]	[ ]	[ ]
Cobalt, Total	[ ]	[ ]	[ ]
Color	[ ]	[ ]	[ ]
Fluoride	[ ]	[ ]	[ ]
Iron, Total	[ ]	[ ]	[ ]
Magnesium, Total	[ ]	[ ]	[ ]
Molybendum, Total	[ ]	[ ]	[ ]
Maganese, Total	[ ]	[ ]	[ ]
Nitrate-Nitrite (as N)	[ ]	[ ]	[ ]
Oil & Grease	[ ]	[ ]	[ ]
Petroleum Hydrocarbons	[ ]	[ ]	[ ]
pH(in S.U.)	[ ]	[ ]	[ ]
Phosphorous, Total(as P)	[ ]	[ ]	[ ]
Radioactivity	[ ]	[ ]	[ ]
Sulfate(as SO4)	[ ]	[ ]	[ ]
Sulfide(as S)	[ ]	[ ]	[ ]
Sulfite(as SO3)	[ ]	[ ]	[ ]
Surfectants	[ ]	[ ]	[ ]
Temperature(°C)	[ ]	[ ]	[ ]
Tin, Total	[ ]	[ ]	[ ]
Titanium, Total	[ ]	[ ]	[ ]
TKN(as N)	[ ]	[ ]	[ ]
Total Organic Carbon	[ ]	[ ]	[ ]
Total Dissolved Solids	[ ]	[ ]	[ ]
Total Suspended Solids	[ ]	[ ]	[ ]

SECTION 4. SITE PLAN

Please provide a site plan indicating all activities which make-up the proposed discharge and indicate the proposed connection to the wastewater collection system.

SECTION 5. CERTIFICATION

This is to be signed by an authorized representative of the Applicant/Responsible Party **after** completion and review of the information in this Temporary Discharge Application.

I have personally examined and am familiar with the information submitted in sections1, 2, 3, 4 and all attachments. Based upon my inquiry of those individuals immediately responsible for obtaining the information reported herein, I believe that the submitted information is true, accurate and complete, I am aware that there are significant penalties for submitting false information, including the possibility of fine and/or imprisonment.

______________________________________ ____________________

Signature of Authorized Representative* Date

____

Name & Title

Return completed application and all other correspondence to: Middlesex County Utilities Authority, P.O. Box 159, Sayreville, NJ 08872. Attention: Environmental Quality (732)721-3800

*Signatory Requirements For Applicant/Responsible Party

The Temporary Discharge Approval shall be signed as follows:

(1). By a responsible corporate officer, if the Applicant/Responsible Party is a corporation. For the purpose of this paragraph, a responsible corporate officer means (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principle business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operation facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2). By a general partner or proprietor if the Applicant/Responsible Party is a partnership or sole proprietorship respectively.

(3). By a director or highest official appointed or designated to oversee the operation and performance of the activities of the government facility, if the Applicant/Responsible Party is a Federal, State, or local government facility.

(4). By a duly authorized representative of the individual designated in paragraph (1) through (3) above if:

(i). The authorization is made in writing by the individual described in paragraph (1) through (3);

(ii). the authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the discharge originates, such as the position of plant manager, operator of a well, or well field superintendent, or a position of equivalent responsibility, or having overall responsibility for environmental matters for the company; and

(iii). the written authorization is submitted to the Middlesex County Utilities Authority.

(5). If an authorization under paragraph (4) above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or overall responsibility for environmental matters for the company, a new authorization satisfying the requirements of paragraph (4) above must be submitted to the Middlesex County Utilities Authority prior to or together with any reports to be signed by an authorized representative.

EXHIBIT A
MIDDLESEX COUNTY UTILITIES AUTHORITY
DISCHARGE LIMITATIONS
TDA No.

APPLICANT:
EFFECTIVE DATE:
EXPIRATION DATE:

Waste[1] Characteristics[1]	Daily Maximum	Maximum Monthly Ave.	Monitoring Frequency	Sample Type
Arsenic(Total)	3.000	1.000		Composite
Cadmium(Total)	0.690	0.260		Composite
Chromium(Total)	0.230	0.120		Composite
Chromium (Hexavalent)	0.110	0.060		Composite
Copper(Total)	1.100	0.360		Composite
Lead(Total)	0.600	0.400		Composite
Mercury(Total)	0.110	0.048		Composite
Nickel(Total)	0.360	0.170		Composite
Silver(Total)	0.430	0.240		Composite
Zinc (Total)	2.200	0.660		Composite
Total Toxic Organics[2]	2.13	N/L[3]		
Volatile Compounds				Grab
Base/Neutral Compounds				Composite
Acid Extractable Compound				Composite
Pentane	Monitoring Only			Grab
TBA	Monitoring Only			
MTBE	Monitoring Only			
PCB'S/Pesticides	BMDL[4]	BMDL[4]		Composite
pH (Standard Units)	5.0<Ph <12.5			Grab
Total Petroleum Hydrocarbons	100	N/L[3]		Grab
Flow (Total not to exceed)			Continuous	
Flow (Gallons per day)			Continuous	
Flow (Gallons per minute)			Continuous	

[1] All units in mg/l, unless otherwise noted
[2] Total Toxic Organics are defined in Attachment A
[3] N/L No Limitation Established At This Time
[4] BMDL: Below Minimum Detection Limit

Form Rev.01/24/02

ATTACHMENT A

TOTAL TOXIC ORGANICS

The Term "TTO" shall mean Total Toxic Organics, which is the summation of all quantifiable values greater than 0.01 milligrams per liter (10 ppb) for the following toxic Organics:

Base/Neutral

Acenaphthene
Acenaphthylene
Anthracene
Benzidine
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (ghi) perylene
Benzo (k) fluoranthene
3,4, -Benzofluoranthene
Bis (2-chloroethoxy) methane
Bis (2-chloroethyl) ether
Bis (2-chloroisopropyl) ether
Bis (2-ethylhexyl) phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
2-Chloronaphthalene
4-Chorophenyl phenyl ether
Chrysene
Di-n-butyl phthalate
Di-n-octyl phthalate
Dibenzo (a, h) anthracene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2,4-Trichlrobenzene
Diethyl phthalate
Dimethyl phthalate
2,4-Dinitrotoluene
2,6-Dinitrotoluene
1,2-Diphenylhyrazine
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno (1,2,3-cd) pyrene
Isophorone
Naphthalene
Nitrobenzene
N-nitrosodi-n-propylamine
N-nitrosodimethylamine
N-nitrosodiphenylamine
Phenanthrene
Pyrene
3,3-dichlorobenzidine
2,3,7,8-tetrachloro-dibenzo-p-dioxin

Acid Extractable

2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
4,6-Dinitro-o-cresol
2,4-Dinitrophenol
2-Nitrophenol
4-Nitrophenol
p-Chloro-m-cresol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

Pesticides/PCB’s

Aldrin
alpha-BHC
beta-BHC
gamma-BHC (Lindane)
delta-BHC
Chlordane
4,4’-DDD
4,4’-DDE
4,4’-DDT
Dieldrin
alpha-Endosulfan
beta-Endosulfan
Endosulfan sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

Volatile Organics

Acrolein
Acrylonitrile
Benzene
Bis (chloromethyl) ether
Bromoform (Tribromomethane)
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
2-Chloroethyl vinyl ether
Chloroform (Trichloromethane)
Dichlorobromomethane
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
1,2-Dichloropropane
1,3-Dichloropropylene
Ethylbenzene
Methyl bromide (Bromomethane)
Methyl chloride (Chloromethane)
Methylene chloride (Dichloromethane)
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,2,-trans-Dichloroethylene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluromethane
Vinyl Chloride (Chloroethylene)
Xylene

Appendix H:

Technical Impracticability Memo

Technical Impracticability Evaluation
July 2014

EXECUTIVE SUMMARY

This Technical Impracticability evaluation discusses the justification for a waiver of Applicable or Relevant and Appropriate Requirements (ARARs) for the groundwater that has the potential to discharge to Bound Brook in Operable Unit 4 (OU 4) of the Cornell-Dubilier Electronics (CDE) Superfund Site (Site) [EPA ID: NJD981557879] in South Plainfield, New Jersey. This Technical Impracticability (TI) evaluation was prepared in accordance with the United States Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9234.2-25, *Guidance for Evaluating the Technical Impracticability of Groundwater Restoration* (TI Guidance) (USEPA 1993) on behalf of the U. S. Army Corps of Engineers (USACE), Kansas City District, and USEPA Region 2. It should be noted that the contents of this evaluation are considered to be an addendum to the TI Evaluation Report for Operable Unit 3: Groundwater, dated 2012. This document can be found in the OU4 Administrative Record.

As discussed in Section 1.5.4 of the OU4 Feasibility Study (FS), a TI waiver was invoked for OU3 groundwater in the OU3 Record of Decision (ROD; USEPA, 2012). As per pages 49-50 of the OU3 ROD, USEPA deferred action on the portion of the OU3 groundwater plume that had the potential to discharge to Bound Brook, pending completion of the Remedial Investigation (RI) and FS for OU4. The OU4 RI objectives included investigation of uncertainties about the fate and transport of polychlorinated biphenyls (PCBs) from groundwater to Bound Brook and associated human and ecological health risks. The deferred action area covers shallow groundwater to an approximate depth of 65 feet below ground surface (bgs) along Bound Brook between the Lakeview Avenue Bridge and the twin culverts located proximal to the former CDE facility.

The primary findings of the OU4 RI/FS regarding groundwater discharge to Bound Brook were as follows:

- Contaminated groundwater is discharging to the Brook between river mile (RM) 5.8 and RM6.6, referred to as the “groundwater discharge zone” (Louis Berger, OU4 Final RI, Section 7.0).

- Data from porewater and surface water samples in the groundwater discharge zone show detected total volatile organic compound (VOC) concentrations between 2,200 µg/L and 4,100 µg/L between RM6.3 and RM6.4 (Louis Berger, OU4 Final RI, Section 7.5.1) and surface water total PCB concentrations averaging approximately 75 ng/L (parts per trillion) between RM6.1 and RM6.5 (Louis Berger, OU4 Final RI, Section 7.5.2).
- Porewater data were compared to USEPA regional screening levels for drinking water and the following chemicals exceeded screening criteria: benzene, 1,4-dichlorobenzene, 1,1-dichlorethane (DCE), cis-1,2-DCE, trans-1,2-DCE, trichloroethane (TCE), vinyl chloride, total PCB congeners, and 2,3,7,8-tetrachlorodibenzodioxin toxic equivalence (TCDD TEQ) (PCBs) (Louis Berger, OU4 Final RA, Section 4.1.1.3).
- Porewater data were compared to Ecological Screening Values (ESVs) protective of aquatic life. Vinyl chloride, cis-1,2-DCE, total PCB congeners, and TCDD TEQ (PCBs) yielded Hazard Quotients greater than 1 and were selected as COPECs (Louis Berger, OU4 Final RA, Section 5.3.1.2).

The OU4 RI findings confirmed the transport of groundwater contaminants to Bound Brook via porewater discharge. Because the FS alternatives evaluated for the OU4 groundwater remedial action area (GW RAA) do not include remediation of the groundwater contaminant source and only address the discharge of contaminated groundwater to Bound Brook (treatment of the contaminated groundwater source area was determined to be impractical via the TI Evaluation for OU3 Groundwater [Louis Berger/ARCADIS, 2012]), a TI waiver is being sought for the area of groundwater that discharges to Bound Brook. The location of the TI Zone for OU4 is shown on Figure 1. This TI evaluation was prepared as an appendix to the OU4 FS, since the data collected during the RI and the evaluation of remedial technologies in the FS are sufficient to identify the critical limitations to groundwater remediation. Further, this evaluation discusses the impact of these critical limitations on contaminant distribution, restoration potential, and the effectiveness of currently available remedial technologies.

SITE LOCATION AND BACKGROUND

Cornell-Dubilier Electronics, Inc. operated a facility at 333 Hamilton Boulevard in South Plainfield, New Jersey from 1936 to 1962, manufacturing electronic parts and components, including capacitors. The company released material contaminated with PCBs and other hazardous substances, including chlorinated solvents, directly onto the soil during its operations. USEPA detected PCBs and chlorinated solvents in the groundwater and soil at the former CDE facility and PCBs on nearby residential, commercial and municipal properties.

USEPA also detected PCBs in the surface water and sediments of Bound Brook, adjacent to the former CDE facility property. Bound Brook is a major tributary of Green Brook, a tributary of the Raritan River, and is classified as freshwater, non-tidal. The "Site" refers to the four operable units (OUs) which comprise the CDE Superfund Site, and the extent of each OU investigation. The four OUs designated by USEPA are as follows:

- OU1 addresses residential, commercial, and municipal properties in the vicinity of the former CDE manufacturing facility. USEPA signed a ROD for OU1 in 2003 (USEPA, 2003). Remediation activities in OU1 are substantially complete.
- OU2 addresses contaminated soil and buildings at the former CDE facility. USEPA signed a ROD for OU2 in 2004. Soil remediation activities at OU2 were completed in 2012. The "former CDE facility" refers to the physical extent of the industrial park operated at 333 Hamilton Boulevard.
- "OU3" refers to the geographic extent of the groundwater contamination and associated investigation. USEPA signed a ROD for OU3 in September 2012 that specified that groundwater discharge to Bound Brook is to be evaluated during the OU4 RI, with a final remedy decision for this part of the aquifer to be made as part of the OU4 remedy.
- "OU4" addresses contaminated sediment and soils in Bound Brook, Green Brook, portions of Cedar Brook (including Spring Lake), two other unnamed tributaries to Bound Brook, and the associated floodplain areas, as well as buried capacitor debris, contaminated groundwater discharges to surface water (within Bound Brook), and a water line crossing the former CDE facility property. OU4 refers to the geographic extent of the contaminated sediment, floodplain soil, capacitor debris, contaminated groundwater discharge areas to surface water, and associated investigations.

SITE GROUNDWATER

Regional Hydrogeology

In the area of the former CDE facility property, the Passaic Formation generally forms a leaky multi-aquifer system that is several hundreds of feet thick. Groundwater movement is primarily through bedding plane fractures and steeply dipping, interconnected fractures and dissolution channels (secondary permeability). A very limited amount of groundwater flows through the interstitial pore spaces between silt or sand particles because of compaction and cementation of the formation. Differences in permeability between layers resulting from variations in fracturing and weathering may account for many water-bearing units.

Groundwater in the Passaic Formation is often unconfined in the shallower, more weathered part of the aquifer; however, silt and clay derived from the weathering process typically fill fractures, thereby reducing permeability. This relatively low permeability surface zone reportedly extends 50 to 60 feet bgs (Michalski, 1990). Groundwater in the deeper portion of the Passaic Formation is generally confined as the lack of vertical fractures can create a confining effect with depth.

Local and regional groundwater discharge boundaries include surface water bodies like Bound Brook. However, municipal pumping centers (water wells) account for most of the regional groundwater discharge.

Site Hydrogeology

The bedrock aquifer investigated as part of the OU3 RI was divided into three hydrogeologic units, or water-bearing zones, identified as the "shallow," "intermediate," and "deep" zones. The shallow water bearing zone is unconfined and extends from the water table to a depth of approximately 120 feet bgs (bedrock). Groundwater in the upper few feet of this water bearing zone is hydraulically connected to surface water bodies including Bound Brook, Cedar Brook, and Spring Lake. The TI waiver for OU3 deferred action on the zone of groundwater extending to a depth of approximately 65 feet bgs that is potentially impacting water quality in Bound Brook. The lateral limits of this discharge zone are roughly defined by the Lakeview Avenue Bridge (RM6.2) and the twin culverts (RM6.6) located northeast of the former CDE facility property.

Groundwater in lower water-bearing zones is not hydraulically connected to surface water bodies and cannot discharge to Bound Brook, due to the lack of vertical fractures. This evaluation does not address the intermediate or deep groundwater zones, which were already addressed by the OU3 TI waiver.

The following investigation tools and subsequent lines of evidence gathered during both the OU3 and OU4 RIs indicate that contaminated groundwater from the shallow zone is discharging into Bound Brook, with potential long-term impacts on conditions in the brook:

- Stream flow and surface water quality investigations conducted to evaluate changes in flows and water quality in the brook.
- Particle tracking modeling.
- Porewater sampling conducted to measure VOC and PCB concentrations in porewater and surface water in Bound Brook adjacent to the former CDE facility.

- Surface water sampling conducted to measure VOCs in surface water samples from Bound Brook.

The findings of these efforts, presented in the OU4 RI, included the following:

- Bound Brook is a gaining stream near the former CDE facility, under current hydraulic conditions, including groundwater extraction for municipal supply. Of particular note, contaminated groundwater is discharging to the Brook between RM5.8 and RM6.6 (Louis Berger, OU4 Final RI, Section 7.0).
- Particle tracking modeling conducted during the OU4 RI indicates that that a portion of the OU3 plume is discharging to Bound Brook (Louis Berger OU4 Final RI, Section 7.0)
- Porewater and surface water sampling data collected in the groundwater discharge zone detected VOC concentrations between 2,200 µg/L and 4,100 µg/L between RM6.3 and RM6.4 (Louis Berger, OU4 Final RI, Section 7.5.1) and surface water total PCB concentrations averaging approximately 75 ng/L between RM6.1 and RM6.5 (Louis Berger, OU4 Final RI, Section 7.5.2).

Based on the lines of evidence indicating that contaminated groundwater discharges to Bound Brook, risk screening was conducted. Porewater data were compared to USEPA regional screening levels for drinking water and the following chemicals exceeded screening criteria: benzene, 1,4-dichlorobenzene, DCE, cis-1,2-DCE, trans-1,2-DCE, TCE, vinyl chloride, total PCB congeners, and TCDD TEQ (PCBs) (Louis Berger, OU4 Final RA, Section 4.1.1.3). Porewater data were compared to ESVs protective of aquatic life. Vinyl chloride, cis-1,2-DCE, total PCB congeners, and TCDD TEQ (PCBs) yielded Hazard Quotients greater than 1 and were selected as COPECs (Louis Berger, OU4 Final RA, Section 5.3.1.2).

Natural attenuation processes were evaluated as part of the OU3 RI and while conditions for natural attenuation have been found at the site, its scope is limited and unlikely to prevent the discharge of contaminants from groundwater into Bound Brook for the foreseeable future.

EVALUATION OF SITE RESTORATION POTENTIAL

Under CERCLA, groundwater restoration cleanup levels are established by chemical-specific ARARs. To evaluate the potential for groundwater restoration at OU4, the impact of contaminant distribution within a rock matrix and the areal extent of the plume have on the effectiveness of currently available remedial technologies were evaluated in the FS. In reviewing general response actions (GRAs) for addressing contaminated groundwater discharges to surface water in OU4, consideration was given to the results of work completed for OU2 and OU3.

There are two common GRAs for addressing groundwater contamination: removal and containment.

- ***Removal*** GRAs (*i.e.*, extraction) are designed to collect and treat contaminated groundwater, reducing the mass or toxicity of contaminants.
- ***Containment*** GRAs (*i.e.*, hydraulic control) are intended to prevent the migration of contaminated groundwater.

In the OU3 RI, ***removal*** was not considered an applicable GRA because most of the OU3 contaminant mass is present in the bedrock matrix and determined to be technically impracticable (Louis Berger/ARCADIS, 2012) to reduce the volume, mobility, or toxicity of the contaminants through extraction and treatment. Similarly, ***removal*** GRAs were generally not considered practicable for OU4. The conditions that apply in OU3 impact the ability to restore groundwater quality in OU4 as well. Contaminants discharging to Bound Brook are contained within a bedrock matrix and released slowly over time. While it may be feasible to remove some of the contaminants from the immediate area of the Brook, given the much smaller area compared to the entire OU3 contaminant plume, there are a number of limitations to this approach. The primary drawback is that back diffusion from the surrounding contaminated bedrock would recontaminate the groundwater. And finally, technologies with the proven ability to successfully remove contaminants from a bedrock matrix are limited. Refer to Section 6 of the FS for further in-depth reviews of potential treatment technologies.

On the basis of this analysis, ***containment*** was retained as an applicable GRA for OU4 since modeling performed as part of the OU3 RI indicated that it was feasible to control the migration of contaminated groundwater in the upper portions of the aquifer through a limited pump and treat system. Containment options (*i.e.*, hydraulic control) through groundwater extraction removes only the contaminant mass that is present in the bedrock fractures within the area of hydraulic influence and is not intended to remediate the entire groundwater plume that includes bedrock pore water (matrix).

ARARS

The TI Evaluation for OU3 Groundwater discussed the ARARs that required waiver: Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act; and New Jersey Safe Drinking Water Quality Act MCLs (NJAC 7:10-16), and the New Jersey Groundwater Quality Criteria (GQCs) (NJAC 7:9-6). The MCLs and MCLGs are chemical-specific requirements for the contaminants present in the groundwater in OU3. Since the bedrock aquifer at OU3 is used a source of drinking water, MCLs and MCLGs are considered to be applicable requirements. The New Jersey MCLs and GQCs set the requirements for drinking water quality in the State of New Jersey. By rule, these requirements are as stringent, or more stringent, than those promulgated by the federal Safe Drinking Water Act.

JUSTIFICATION FOR TECHNICAL IMPRACTICABILITY

A TI waiver was invoked for OU3 in the OU 3 ROD (USEPA 2012) with the need for a waiver for the area of groundwater with the potential to discharge to Bound Brook deferred to be addressed as part of OU4 (Bound Brook corridor). It is appropriate to extend the waiver to the area that was deferred in the OU3 ROD and known to be within the OU4 Bound Brook corridor. The additional OU4 TI waiver being sought utilizes the information developed for the OU3 waiver (See the OU3 RI – TI Evaluation Report for additional details) along with the OU4 RI groundwater results and conclusions. As was the case with OU3, there are significant Site-specific factors that limit the ability to achieve groundwater ARARs in OU4.

1. The highly conductive fracture network at the Site allows for the vertical and horizontal advection of groundwater and aqueous-phase contaminant mass.
2. Samples of the bedrock matrix and groundwater show that contaminants have adsorbed into the bedrock matrix.
3. The untreated contaminants present at the former CDE facility and in the shallow OU3 groundwater plume remain a source of contaminants discharging to OU4. Treatment of contaminants to achieve groundwater ARARs does not address the source area, which over time will recontaminate OU4 groundwater.
4. Site restrictions such as access and routine flooding, limit the ability to construct and operate a treatment system within the limits of OU4.
5. To be successful, a remedial technology would have to be capable of treating contamination in the rock matrix and the bedrock fractures. To accomplish this, the technology must be capable of contacting impacted areas and maintaining that contact over a long enough time period to promote treatment in the rock matrix. Based on the review of currently available remedial technologies, there are no technologies capable of achieving these metrics in fractured bedrock in full-scale implementation.

TI ZONE

The USEPA TI Guidance (USEPA 1993) states that at sites where restoration of groundwater to its most beneficial use is technically impracticable, the area over which the decision applies (referred to as the TI Zone) generally will include all portions of the contaminated groundwater that do not meet ARARs. ARARs are waived inside the TI Zone and other measures, such as pathway elimination and/or administrative controls, are used to prevent exposure to human health and the environment. Outside of the TI Zone, ARARs will still apply. In accordance with the TI Guidance, an OU4 TI Zone has been developed that meets these criteria (see Figure 1).

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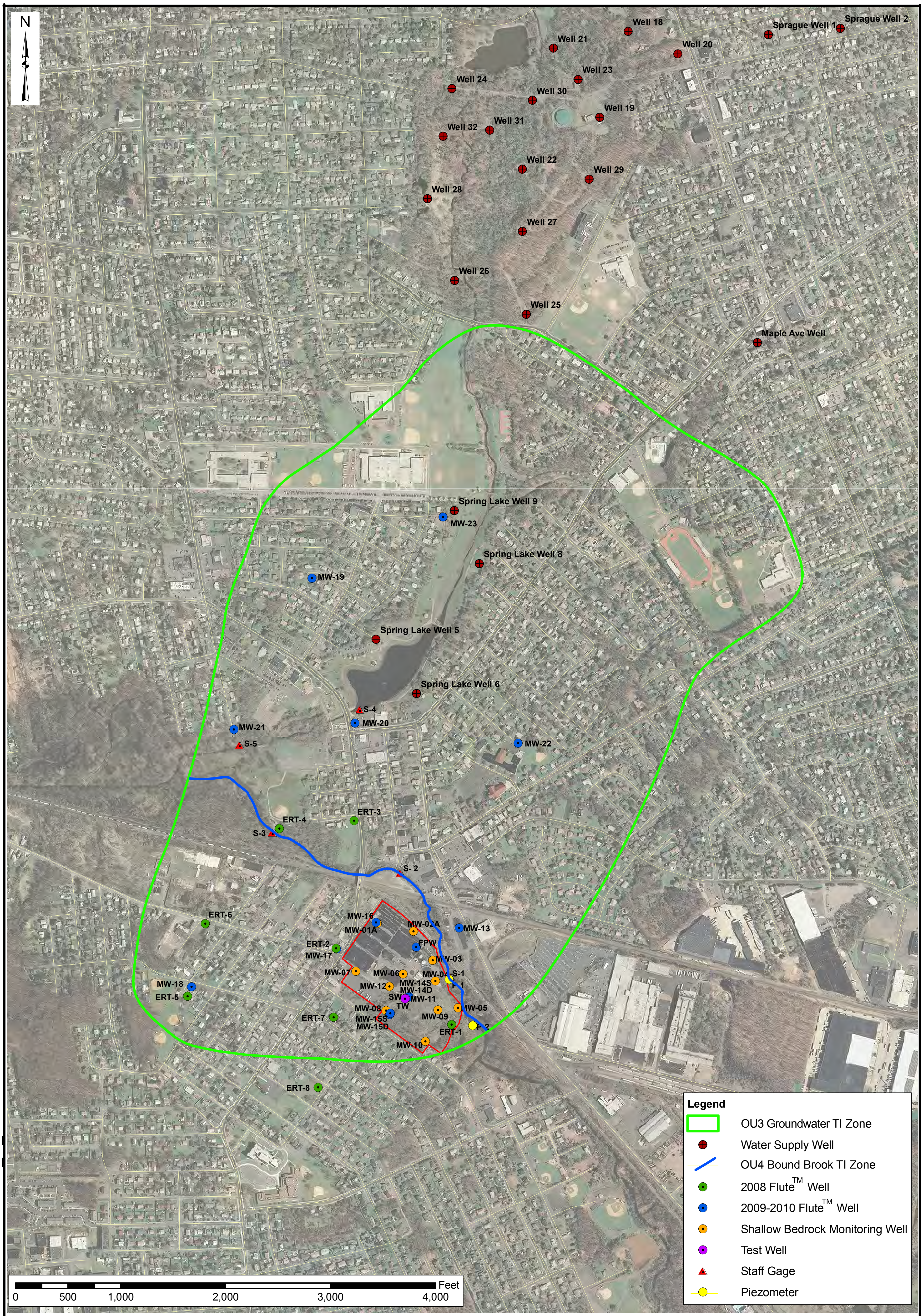

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ARCADIS MALCOLM PIRNIE

Cornell-Dubilier Electronics Superfund Site

South Plainfield, New Jersey

OU4 TI ZONE

Figure 1